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Woodworking Projects
for
Industrial Arts Students

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Woodworking Projects
for
Industrial Arts Students

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WITH A FOREWORD BY
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McGRAW-HILL BOOK COMPANY, INC.
NEW YORK AND LONDON

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WOODWORKING PROJECTS FOR INDUSTRIAL ARTS STUDENTS

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THE MAPLE PRESS COMPANY, YORK, PA.

Preface

This book contains a selection of projects for use in either elementary or junior high school grades. Selected on the basis of student interest, the projects are not intended to be a course of study nor are they arranged according to difficulty. This has been done in the belief that capture of the interest of students is of primary importance, and that subsequent educational achievements depend on intensity of student interest.

Only that information is presented which will help the student plan his work. Mention of specific materials, tools, and equipment is seldom made so that manipulative work can be developed by the teacher to suit his needs. The teacher is encouraged to invite students to modify basic designs of the projects to suit their own needs. Related material, secured from authoritative references, can be presented by the teacher as a part of any project. Good instruction of tool operations by the teacher, together with this book, permits a variety of projects to be made concurrently. The organization of instructional material makes it possible for the students to work with minimum teacher direction.

The authors are grateful to Kennetha S. Schaal for suggestions and assistance in the preparation of the manuscript; to Donald F. Schaal, for help with original drawings; and to Walter Tiede, for permission to use several of his original designs.

Gerald Baysinger,
H[illegible]tley H. Schaal.

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Foreword

Woodworking Projects for Industrial Arts Students provides the student with a selection of interesting projects to make. Each project is presented without dictating the design and without setting up a work procedure so that the student can adapt the project to his own needs. Although the responsibility of planning has been placed on the student, the authors have attempted to anticipate difficulties and warn the student of possible critical points.

This book is not a text in the usual sense, because no attempt has been made to include instruction on tool manipulation. Experience has shown that the teacher can best give instruction on manipulative operations by actual demonstration. In fact this may be considered as one of the indispensable functions of the teacher.

One of the outcomes of industrial arts is the growth in ability of students to work with a minimum of teacher direction. Instead of planning, dictating, and directing each step in the construction of a project, teachers today are giving students opportunities both to plan their work and to work under their own direction. The results achieved have helped us realize that the lock-step method of shop instruction is good production but poor education.

Unfortunately, there is not sufficient instructional material of the kind that provides for individual student planning. Standard project designs and established procedures leave little planning for the student to do. Obviously, there is need for material to place in the hands of the student that will provide for both individual planning and self-direction.

It is believed that this book is another contribution to an expanding and improved system of industrial arts in American education.

EARL L. BEDELL,

Divisional Director of Vocational Education, Detroit Public Schools;
Professor of Vocational Education, Wayne University, Detroit, Michigan.

1. PLANNING IS HELPFUL

This Is Planning. Planning is another name for "thinking through the job"; it is knowing what to do before you start work. An example of good planning is illustrated in Planning Your Project.

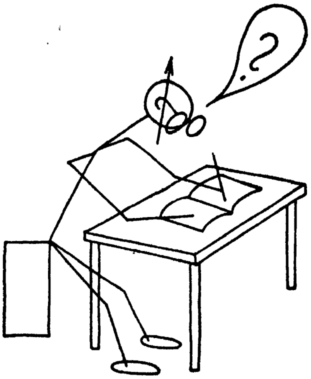


FIG. 1.

This Is a Project. The use of the word "job," "project," or "problem" to describe the article to be made in the school shop is often confusing. The term "project" includes the preparation of the plans for each part and the completed article.

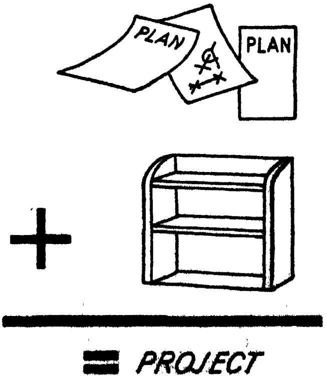


FIG. 2.

This Is a Job. In the sense in which the word "job" is used in this book, it is one of several parts into which a project is divided for ease in planning. A job is a part of the project; it includes the planning and the benchwork that are necessary to accomplish that part of the project.

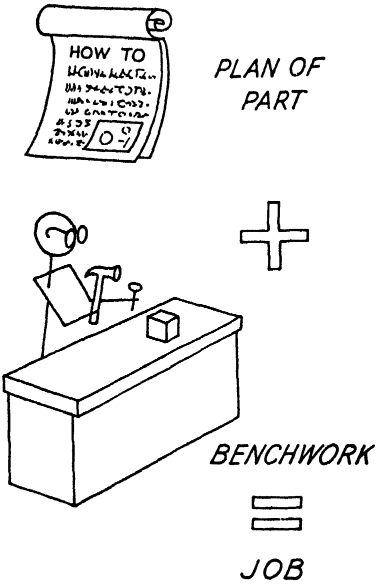


Fig. 3.

How a Project Is Divided. The division of a project into jobs may depend upon the number of parts. A table lamp could thus be considered as consisting of at least two jobs: the base and the upright.

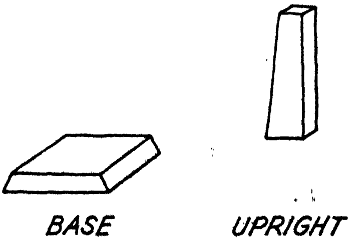


Fig. 4.

A division could also be made according to the material used. The metal blade and tang of a garden trowel could be considered one job, and the wooden handle another.

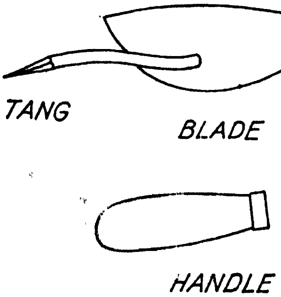


Fig. 5.

The kinds of work to be done provide another basis for dividing a project. Assembling a lamp, wiring it, and applying wood-finishing materials are typical examples.

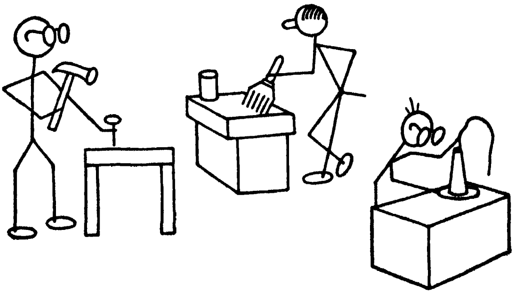


Fig. 6.

To divide some projects into jobs often requires a combination of these methods. An examination of this book will illustrate how different projects have been divided.

Advantages of Dividing a Project into Jobs. One of the reasons for dividing a project into several jobs is to simplify the planning. A project composed of a number of parts often appears complicated. When it is separated into smaller parts, each is easier to plan and to make, and a difficult project becomes a series of easy jobs.

Another reason for such a division is to give the student the feeling of having completed work. Because each job is short and completed quickly, the work is more interesting.

The third reason for separating the project into jobs is to provide the teacher with more opportunities to grade your work. It may not be possible for you to complete the entire project before the end of a card-marking period, but you may have completed several jobs. This makes it easier for the teacher to arrive at a rating that is more in accordance with your work.

The division of a project also makes it possible for you to maintain a better quality of workmanship. It is easier for you to understand the teacher's corrective suggestions because of the fewer number of tool operations. You are encouraged to do your best work on each part and to improve each subsequent part.

Questions Are a Part of Planning. The questions included with each project should reveal to the teacher whether or not you have had enough shop experience to make the project without considerable help from him. The questions also help to limit you to work that is within the range of your ability and in keeping with the class instruction.

How the Projects Were Selected. The projects were selected on the basis of student interest and are intended for use in the elementary and junior high school grades. Most projects can be made with hand tools; none of them requires elaborate equipment. The projects in this book were selected so that they could be used as supplementary material for courses organized and now operating.

2. PLANNING YOUR PROJECT

The projects presented in this book have been selected because other students have enjoyed making them. Some of them may seem difficult to make but, because the parts are simplified in design and require only simple hand-tool operations, they are within the ability of most shop students.

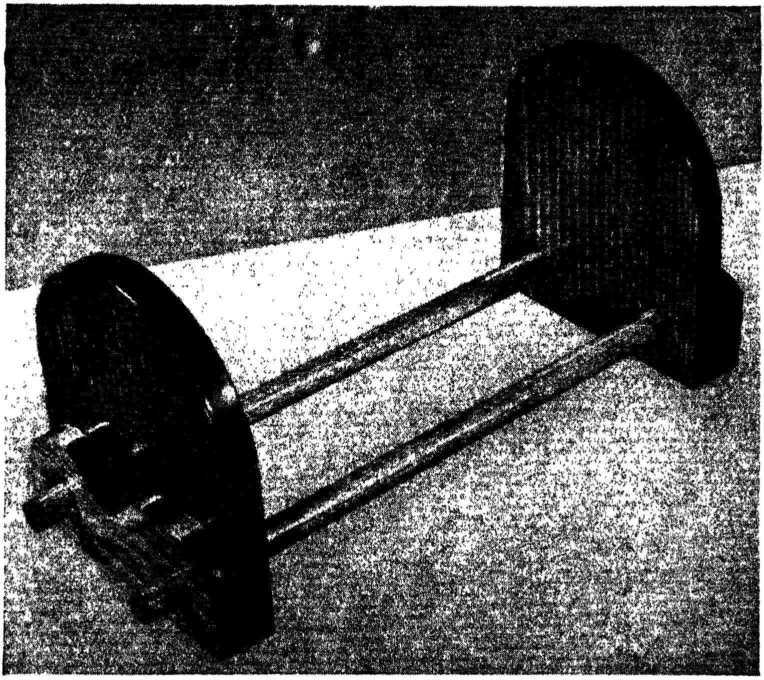


FIG. 7.

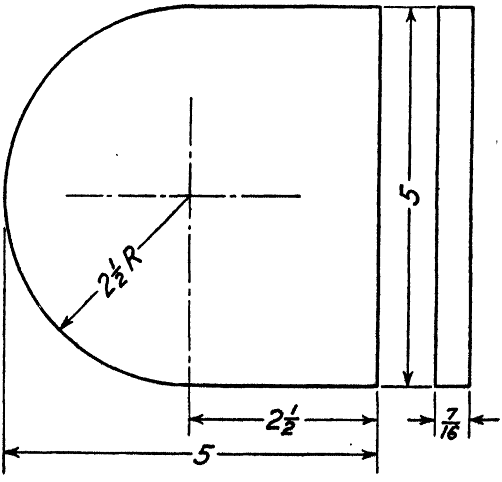
To make any of the projects it is necessary for you to plan your work. Good plans will include the kind and amount of necessary material. Planning is another name for thinking through the job; it is knowing what to do before you attempt to do it. The real reasons for planning are to avoid waste of material and loss of time, and to help you to do a better job.

In this book only the information that will help you plan the project is presented. To show you how to use this information to the best advantage the plans for an adjustable bookrack (Fig. 7) are used as an example.

1. The adjustable bookrack was selected as the project.
2. The design was chosen from design ideas for the ends and end supports.
3. The teacher's approval was secured.
4. The *project* was divided into three jobs:

Job 1. Shape the Ends.
Job 2. Shape the End Supports.
Job 3. Apply the Finish and Assemble.

5. The shop drawing for Job 1 was made on plain notebook paper (Fig. 8).



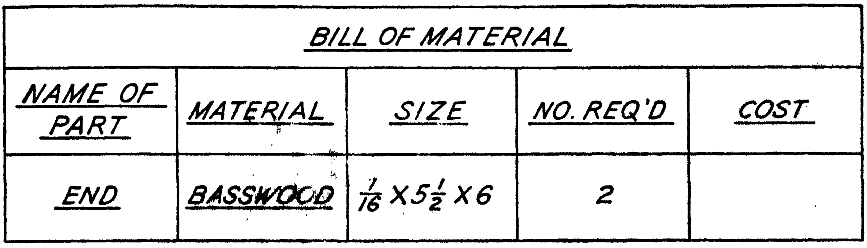
END
2 REQ'D.

FIG. 8.

6. The material needed for Job 1 was determined from the drawing and listed (Fig. 9). This list is called a "bill of material" and, because it will be used when laying out and cutting the rough stock, it is necessary to list the rough sizes. The

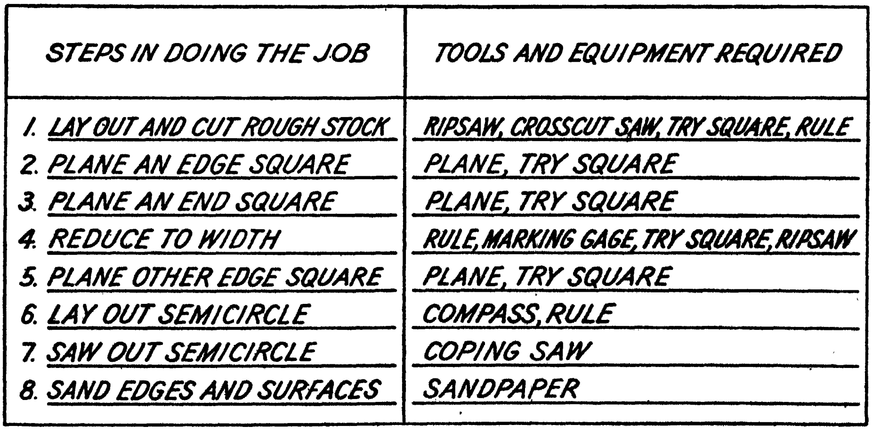
rough size is usually ½ inch wider and 1 inch longer than the finished size shown on the drawing.

7. The Steps in Doing the Job were written and the tools and equipment were listed after each step (Fig. 10). A step in doing a job is a statement of what is to be done. It is usually a tool operation. It is helpful to begin the sentence describing the step with a verb that denotes action. For example, *Saw the end square; Plane the surface; Assemble with screws.* Keep the sentences as short as possible and write them in the order in which the steps are to be performed.



BILL OF MATERIAL				
NAME OF PART	MATERIAL	SIZE	NO. REQ'D	COST
END	BASSWOOD	7/16 X 5½ X 6	2	

FIG. 9.



STEPS IN DOING THE JOB	TOOLS AND EQUIPMENT REQUIRED
1. LAY OUT AND CUT ROUGH STOCK	RIPSAW, CROSSCUT SAW, TRY SQUARE, RULE
2. PLANE AN EDGE SQUARE	PLANE, TRY SQUARE
3. PLANE AN END SQUARE	PLANE, TRY SQUARE
4. REDUCE TO WIDTH	RULE, MARKING GAGE, TRY SQUARE, RIPSAW
5. PLANE OTHER EDGE SQUARE	PLANE, TRY SQUARE
6. LAY OUT SEMICIRCLE	COMPASS, RULE
7. SAW OUT SEMICIRCLE	COPING SAW
8. SAND EDGES AND SURFACES	SANDPAPER

FIG. 10.

8. Knowing the correct answers to the questions at the end of each project may help you in securing the teacher's approval. Then you are ready to begin the manipulative work at your bench.

9. Plan the other jobs that make up the project in the same manner.

To do good work it is necessary to have a plan of work on your workbench. The plan of work should be kept in good condition because you will find it necessary to refer to it many times.

3. ADJUSTABLE BOOKRACK

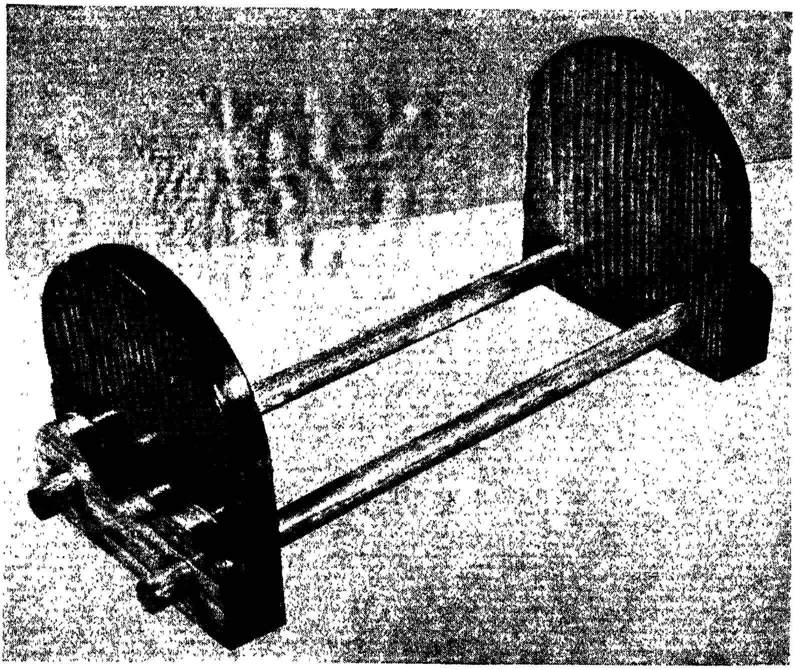


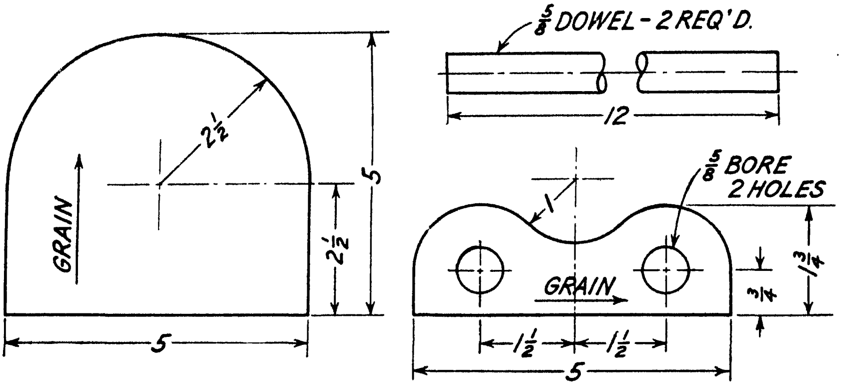
Fig. 11.

This adjustable bookrack (Fig. 11) will help you keep your books in order. The books are held in a position so that the titles may be easily read. The rack is adjustable for any number of books, and the end supports will not slip away and allow the books to fall. Woods of contrasting colors and grain patterns may be used to harmonize with the furniture, or the bookrack may be enameled to fit into the color scheme of your room. The design for the ends and the end supports may be chosen from the suggested designs or an original idea may be worked out. The adjustable bookrack is easy to make and can be made with hand tools.

CONSTRUCTION HELPS

When planning the bookrack it will be helpful to divide the project into several jobs and to plan each job separately:

Job 1. Shape the Ends.
Job 2. Shape the End Supports and Make the End Assemblies.
Job 3. Apply the Finish and Assemble.



END -7/16 STOCK

END SUPPORT -7/16 STOCK

Fig. 12.

The direction of the grain is indicated in Fig. 12. This should be considered when laying out the rough stock.

The centers of the holes must be carefully located to ensure correct assembly. More accuracy may be secured by first nailing the end and end support and then boring the holes. A ⅛-inch pilot hole will aid you in boring the holes at right angles to the surface.

Use care in sanding the dowels, for too much sanding will make them undersize. Apply a rubbed finish, using shellac and oil. Varnish or enamel on the dowel rods will cause the end assemblies to stick, and the bookrack could not be adjusted.

To prevent the bottom of the bookrack from marring a polished surface, attach small pieces of felt or use rubber-headed tacks.

DESIGN IDEAS

The length of the bookrack can be increased by using a longer dowel than the one shown in Fig. 12.

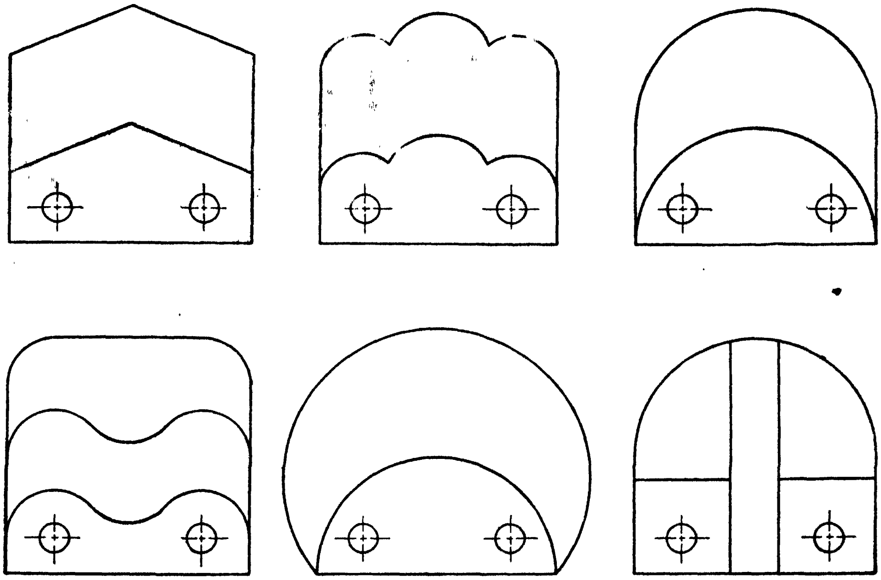


FIG. 13.

The ends and end supports may be of different shapes.

TRY THESE QUESTIONS

1. How long is a standard dowel rod?
2. A No.10 bit will bore what size hole?
3. What kind of handsaw would you use to saw out the end supports?
4. What is the radius of a 5-inch circle?
5. In assembling the end of the bookrack should the brads be clinched across the grain or with the grain?

4. SHELF FOR ODDS-AND ENDS

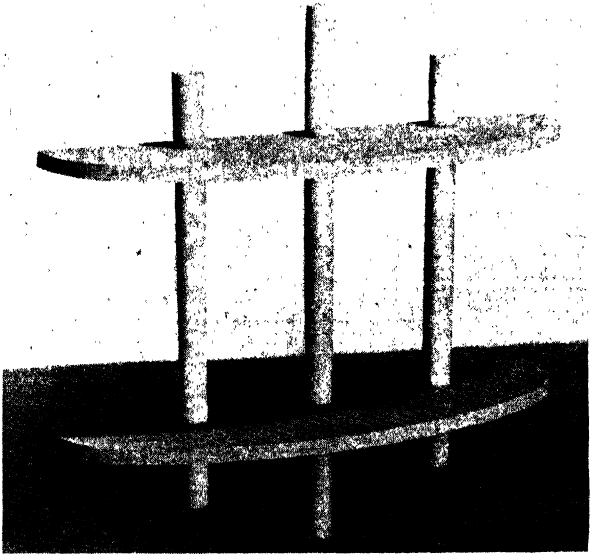


Fig. 14.

The shelf (Fig. 14) for odds and ends is just right for displaying your gadgets and knickknacks. A two-tone finish adds to the attractiveness of the shelf, and it becomes a center of interest in your room. The shelf can be made in a short time with a few hand tools and you may want to make several of them.

THESE HINTS MAY HELP

When preparing your plan of work it will be helpful to divide the project into the following jobs:

Job 1. Shape the Wood Parts (Fig. 15).
Job 2. Apply the Finish and Assemble the Shelf (Fig. 16).

To lay out the curve on the shelf, square one edge of the stock, then lay out the center lines. To draw the curve with

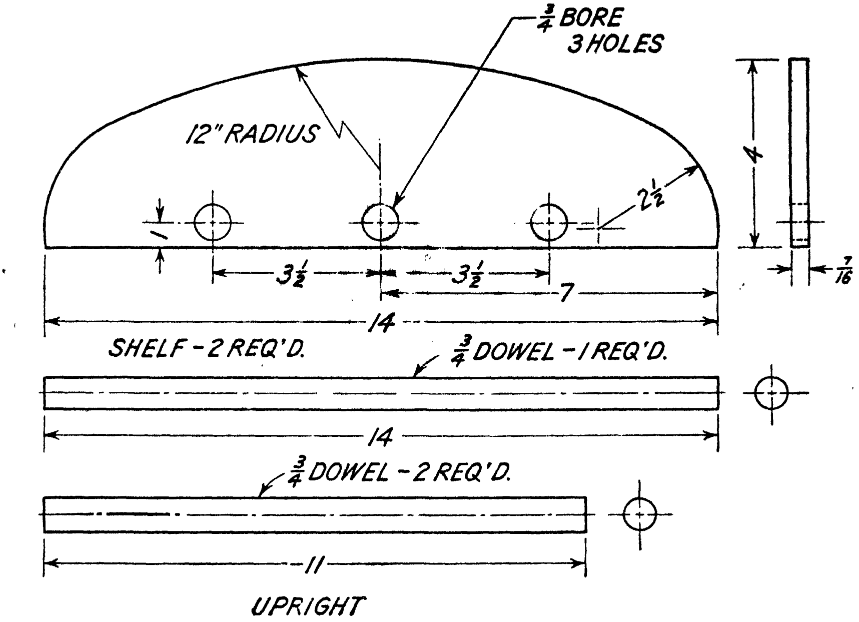
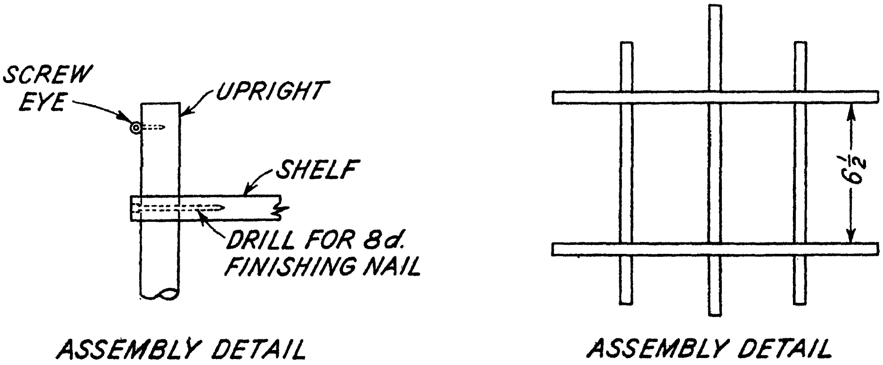


Fig. 15.



ASSEMBLY DETAIL

ASSEMBLY DETAIL

Fig. 16.

the 12 inch radius, extend the center line beyond the stock (Fig. 17). If your dividers are not large enough, use a string and pencil.

Bore the holes through both shelves at the same time. Do not forget to drill pilot holes to prevent the wood from splitting.

The three uprights may be sawed from one dowel without any waste stock. Be accurate with your measurements, and saw the 11-inch lengths first. Sand the dowels very lightly so that they will not be undersize.

If the uprights are to be painted a color different from that of the shelves, it would be an advantage to paint the parts before they are assembled.

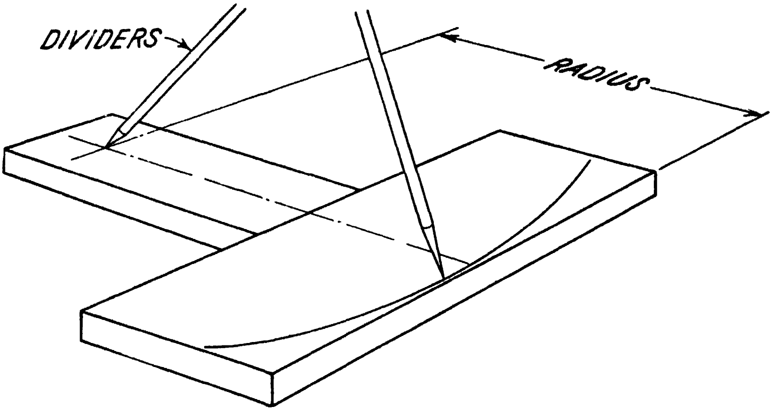


FIG. 17.

The shelf may be hung by means of two screw eyes inserted in the two outside dowels.

Assemble the uprights so that an equal amount extends above and below the shelves.

To prevent the shelves from getting out of alignment, the uprights should be put in place and then a hole drilled for a 8 penny finishing nail. Drive each nail in place before drilling the next hole.

SOME MORE IDEAS

See Fig. 18 for suggestions in different designs.

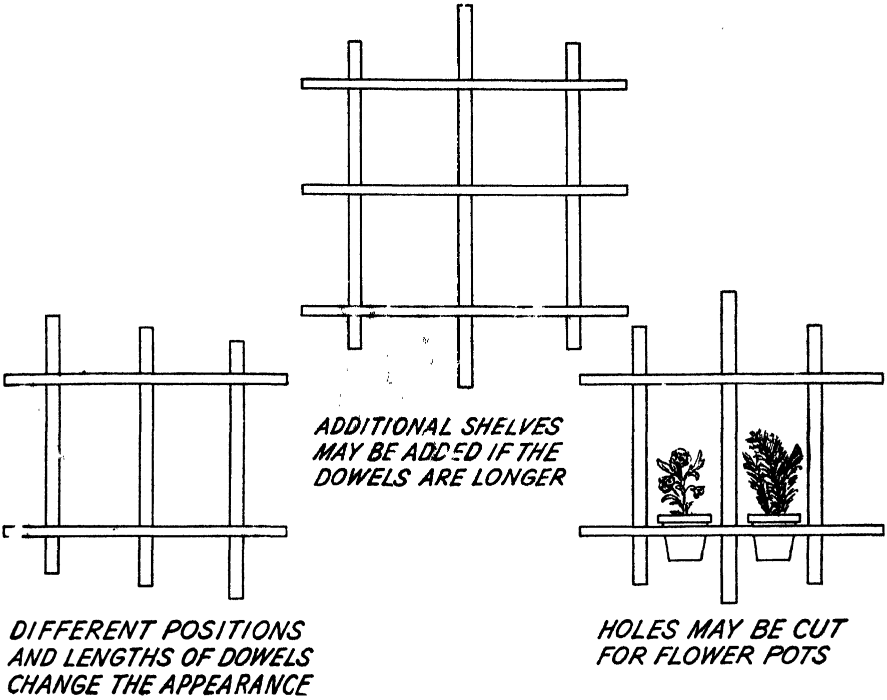

ADDITIONAL SHELVES MAY BE ADDED IF THE DOWELS ARE LONGER
DIFFERENT POSITIONS AND LENGTHS OF DOWELS CHANGE THE APPEARANCE
HOLES MAY BE CUT FOR FLOWER POTS

Fig. 18.

QUIZ YOURSELF

1. If you do not have a pair of dividers that can be set for a 12 inch radius, what may be substituted?

2. What tools are used to draw the center lines at right angles to the squared edge?

3. What tool would you use to cut out the shelves?

4. What number bit would you use to bore the holes for the dowel rods?

5. Why should a hole be drilled for the nails that hold the dowels in place?

5. LEISURE LIGHT

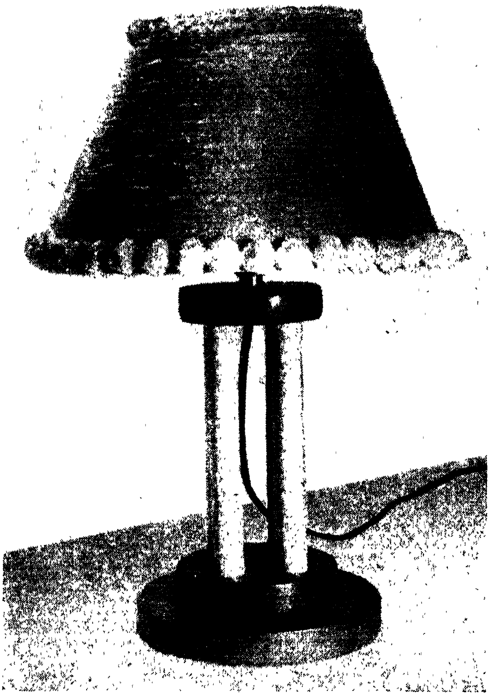


FIG. 19.

The leisure light (Fig. 19), made of woods of contrasting colors, is very attractive and expensive looking. It was designed for use in a boy's room and gives light suitable for evening reading, modelmaking, and other leisure activities. The leisure light is easy to make, requires only a few tools, and makes a presentable gift.

USEFUL SUGGESTIONS

When preparing plans for making the lamp, you will find it helpful to divide the project into the following jobs and to plan each job separately:

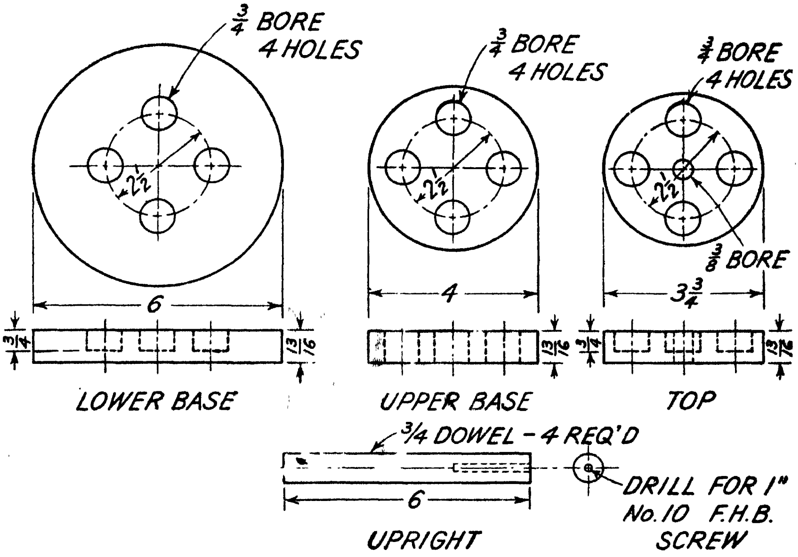

¾ BORE 4 HOLES
2½
6
¾
13/16
LOWER BASE
¾ BORE 4 HOLES
2½
4
13/16
UPPER BASE
¾ BORE 4 HOLES
2½
⅜ BORE
3¾
¾
13/16
TOP
¾ DOWEL - 4 REQ'D
6
UPRIGHT
DRILL FOR 1" No. 10 F.H.B. SCREW

Fig. 20

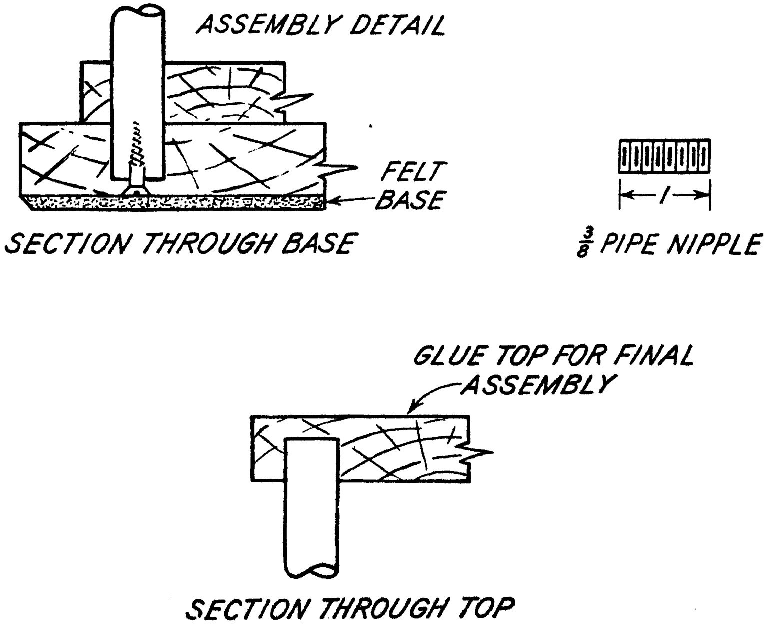

ASSEMBLY DETAIL
FELT BASE
SECTION THROUGH BASE
1
⅜ PIPE NIPPLE
GLUE TOP FOR FINAL ASSEMBLY
SECTION THROUGH TOP

Fig. 21.

Job 1. Shape the Wood Parts (Fig. 20).
Job 2. Make a Trial Assembly of the Wood Parts.
Job 3. Apply the Finish.
Job 4. Assemble (Fig. 21) and Wire the Lamp.

The wood parts may be made of a dark-colored wood such as red gum, mahogany, or walnut. The dowel rod may be purchased for a small sum from the local hardware store or lumberyard. The light socket, plug, wire, lamp shade, and pipe nipple may be secured from the ten-cent store or hardware store.

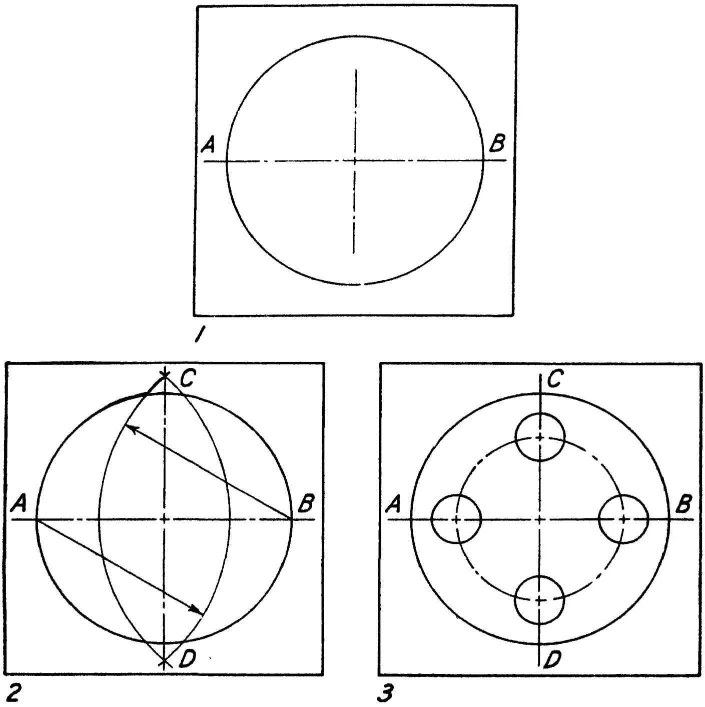


FIG. 22.

The centers of the holes must be accurately located to ensure correct assembly; difficulty is sometimes experienced when the centers of the holes are carelessly located. A suggestion that may help you locate the holes accurately is illustrated in Fig. 22.

To check the layout of the centers, measure the distance between them with a pair of dividers.

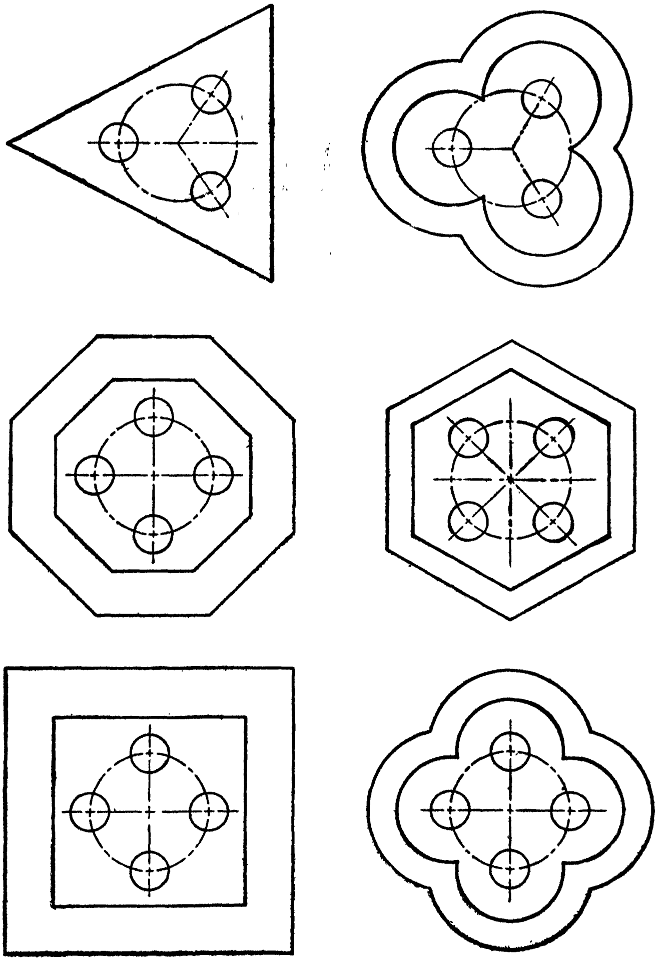


Fig. 23.

A pilot hole drilled with a ⅛-inch drill will aid you in boring the holes at right angles to the surface and will prevent the wood from splitting. Care should be taken to select a sharp bit, because one with burred nibs will not bore a hole of the correct size.

Applying finish to the assembled lamp is difficult because it is hard to brush between and around the dowel rods. Because of this, it is suggested that you apply the finish to the parts after a trial assembly and make the final assembly after the finish is dry.

DESIGN IDEAS

Bases may be of different shapes (Fig. 23).

Variations may be secured either by changing the height of the uprights or by using different types of shades.

Lamps may be varnished to show contrast between the various colors of wood or enameled to harmonize with room decoration.

CAN YOU ANSWER THESE?

1. How many lines are necessary to locate the center of a circle?
2. What is one-half of 3¾?
3. How many 8-inch pieces can be cut from a 36-inch rod?
4. What number is stamped on the tang of a ¾-inch bit?
5. Of what kind of wood are the dowels made?
6. How can chipping be prevented when boring through a piece of wood?

6. SHOE RACK

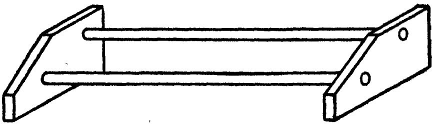


FIG. 24.

This shoe rack (Fig. 24) can be made to hold any number of shoes. It helps you to use your closet space to the best advantage. The rack and shoes are easy to move when the closet is to be cleaned. The shoe rack also serves as a drying rack because it raises the leather soles off the floor and thus allows air to circulate around them. A good feature of this shoe rack is that it does not require hooks or nails for installation.

READ THESE SUGGESTIONS

If the project is divided into the following jobs, the planning will be simplified:

Job 1. Shape the Ends.
Job 2. Assemble and Apply the Finish.

You can avoid splitting the wood when boring the holes for the dowels by drilling a pilot hole for the spur of the bit.

To determine how many dowels you will need, it will be necessary, in most cases, to measure the space where the shoe rack is to be placed. If you cannot secure the size of dowel indicated on Fig. 25, a larger size may be substituted. It is advisable to secure the dowel rod before the holes are bored.

Glue is used to assemble the shoe rack. A finishing nail driven into the end and through the dowel will strengthen the joint. Drill a pilot hole for the nail to prevent splitting. Sand the dowels after the assembly is complete, to prevent loose-fitting joints.

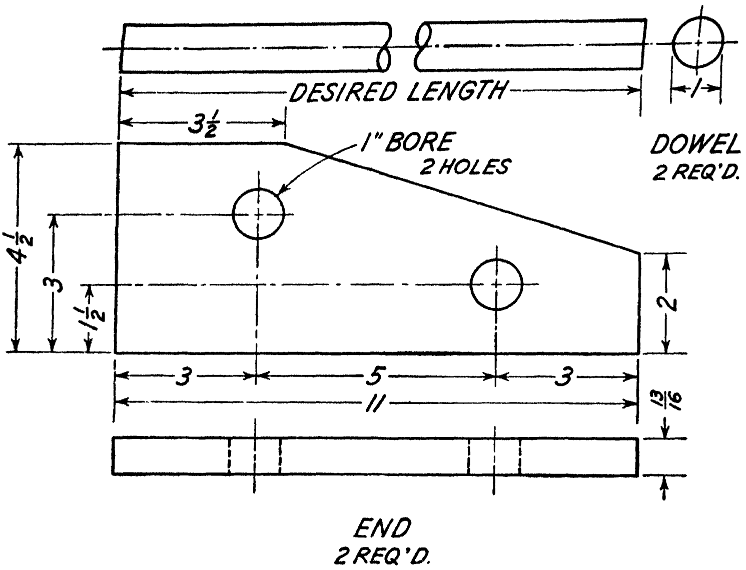
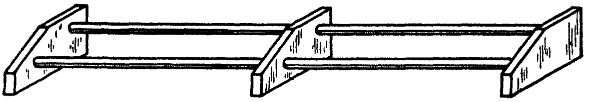


Fig. 25.



AN EXTRA LONG RACK

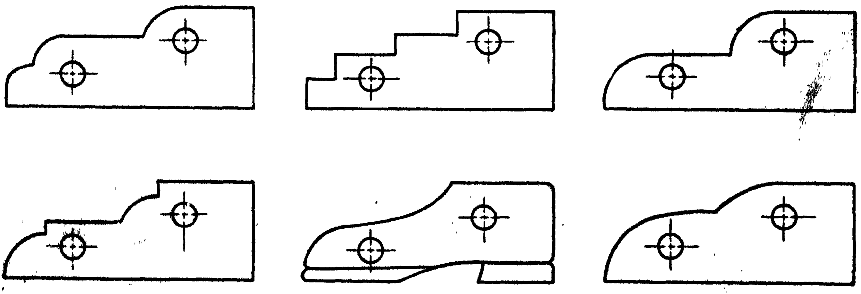


Fig. 26.

Metal gliders, which may be purchased at most ten-cent or hardware stores, are driven into the bottom of the shoe rack after the finish has dried.

DESIGN SUGGESTIONS

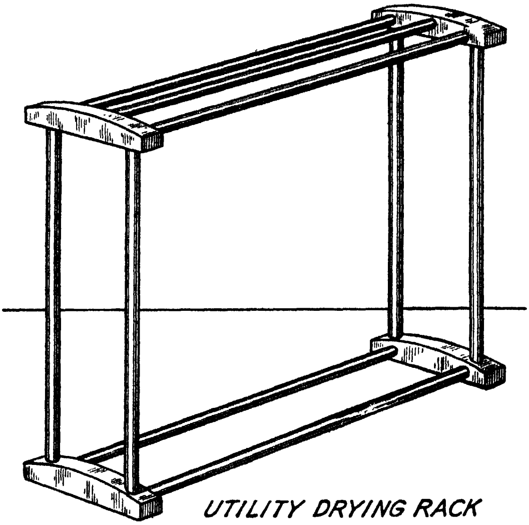
The design for the ends can be varied to harmonize with the style of furniture in the room where the shoe rack is to be used (Fig. 26).

You will probably want to apply the same finish to it as the finish on the woodwork in the room.

SUGGESTED REVIEW

1. How do you plane end grain?
2. What kind of wood do you intend to use for the end pieces?
3. What is the procedure for squaring stock to size?
4. What number bit is used to bore a hole for a ¾-inch dowel?
5. How do you apply the finish that you intend to use?

7. UTILITY DRYING RACK



UTILITY DRYING RACK ASSEMBLY

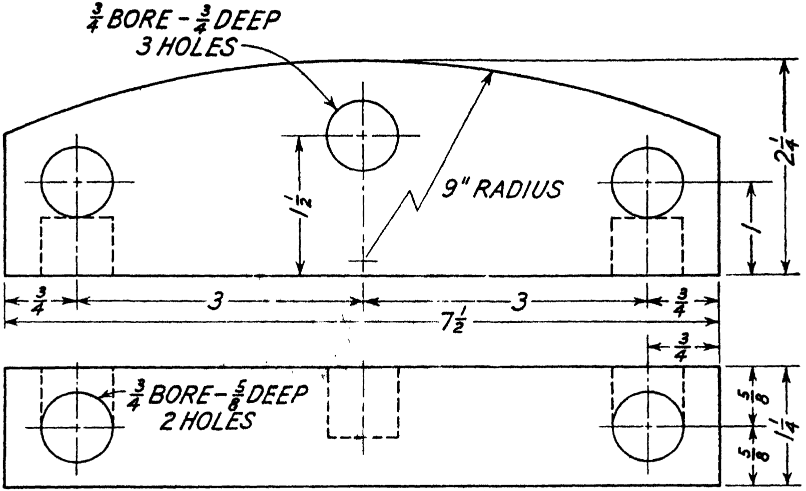
FIG. 27.

The utility drying rack (Fig. 27) is a useful bathroom accessory. It can be used for drying bath towels, washcloths, stockings, and other small articles of clothing. It is portable and can be placed near a radiator or open window to improve drying conditions. Because the cost of the materials for this rack is approximately 15 per cent of the price of a similar article purchased from a store, it is profitable to make it in the school shop.

READ THESE FIRST

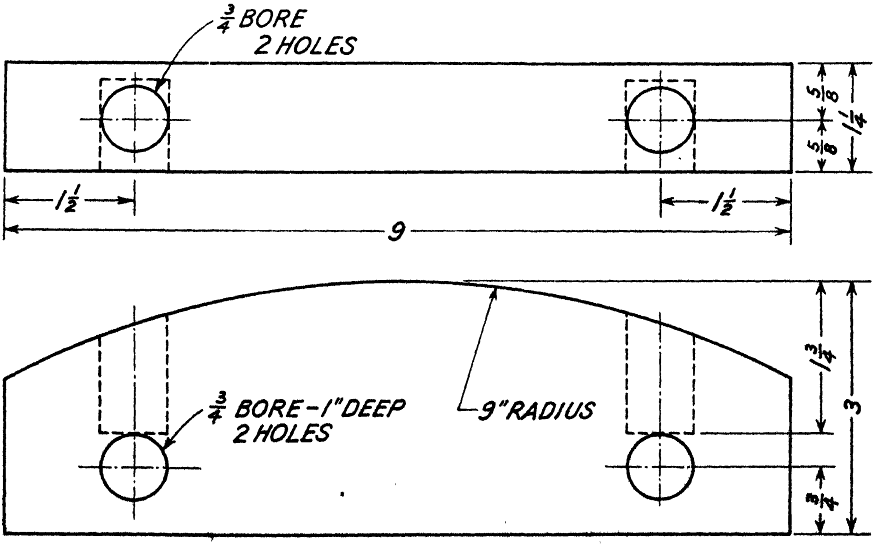
For ease in planning, the drying rack may be divided into the following jobs:

Job 1. Shape the Wood Parts.
Job 2. Assemble the Rack.
Job 3. Apply the Finish.



TOP PIECE - 2 REQ'D.

Fig. 28A.



BOTTOM PIECE - 2 REQ'D.

Fig. 28B.

White pine 2 × 4 may be reduced to thickness and used, if you are unable to obtain 1¼-inch material.

If a power saw is not available, the end pieces may be roughed out with a ripsaw and then planed to the curve shown in Figs. 28*A* and 28*B*.

The holes should be laid out from the center line. Extreme caution should be used when boring the holes for they must be straight in order to assemble the rack properly. It is much easier to bore the holes in the top edge of the bottom piece *before* cutting the curve.

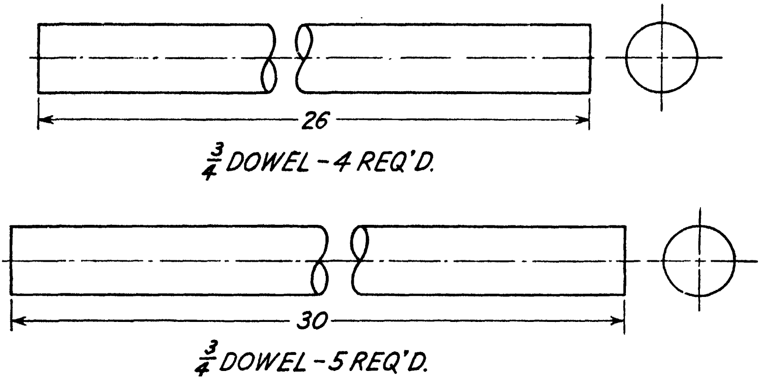


FIG. 28*C*.

In assembling the rack, a waterproof glue such as casein is recommended. Steam and water vapor in the bathroom will weaken joints made with ordinary glue.

Sand the dowels (Fig. 28*C*) after they are assembled to prevent loose-fitting joints.

Large rubber tacks may be used for feet. Rubber is recommended rather than metal gliders because most bathrooms have tile floors.

VARIATIONS IN DESIGN

Some suggestions for varying the design of the end piece are presented in Fig. 29. If you use one of them or if you design your own, it would be best to keep the locations of the holes the same as in the working drawings.

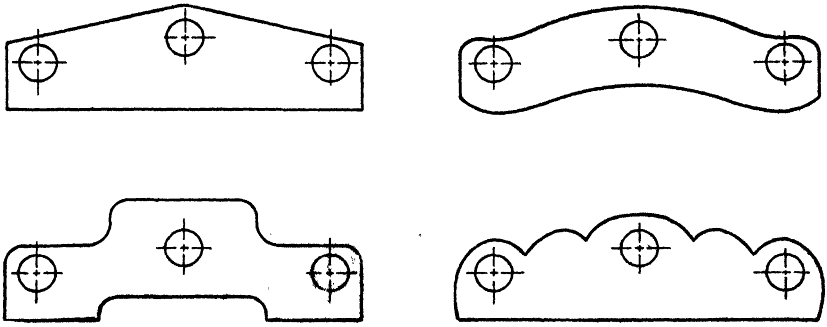


FIG. 29.

The height or length of the rack may be altered to fit a particular place.

The rack may be enameled to match the tile or to harmonize with the color scheme of the room decorations.

QUIZ QUESTIONS

1. What is the compass setting for laying out the curve on the top piece?
2. What method are you going to use to secure the correct depth of hole with a brace and bit?
3. How long should the glue joints be allowed to dry before further work is done?
4. What can be done to prevent the wood from splitting when boring a large hole near the end of a piece of wood?
5. What material is used to thin enamel?

8. SUPPLY BOX

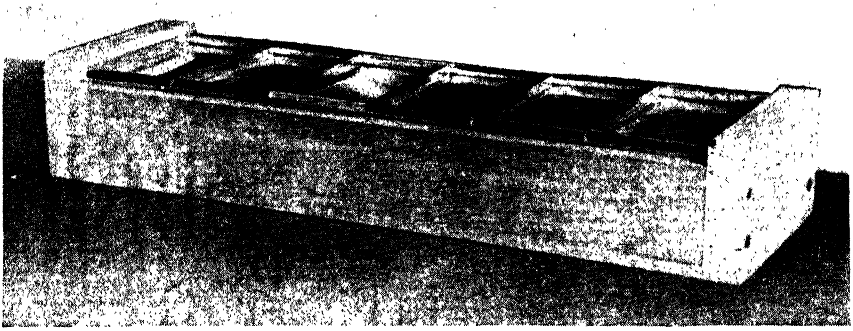


FIG. 30.

This box (Fig. 30), divided into six compartments, was designed to hold nails, screws, faucet washers, nuts and bolts, and other small items needed at home.

The slides are easily operated and prevent the covers from being lost. The covers are constructed so that they may be used as trays when small parts are sorted.

The box is substantially made and will be useful either at home or in the school shop.

HELPFUL CONSTRUCTION HINTS

In making the supply box it will be helpful to divide the project into several jobs and plan each job separately.

Job 1. Shape the Wood Parts (Fig. 31).
Job 2. Assemble the Box.
Job 3. Make and Assemble the Separators and Covers (Fig. 32).

Both the ends and sides must be the same. For this reason, it is necessary to be very accurate. Difficulty in assembling the sliding covers may be avoided if the ends are placed together

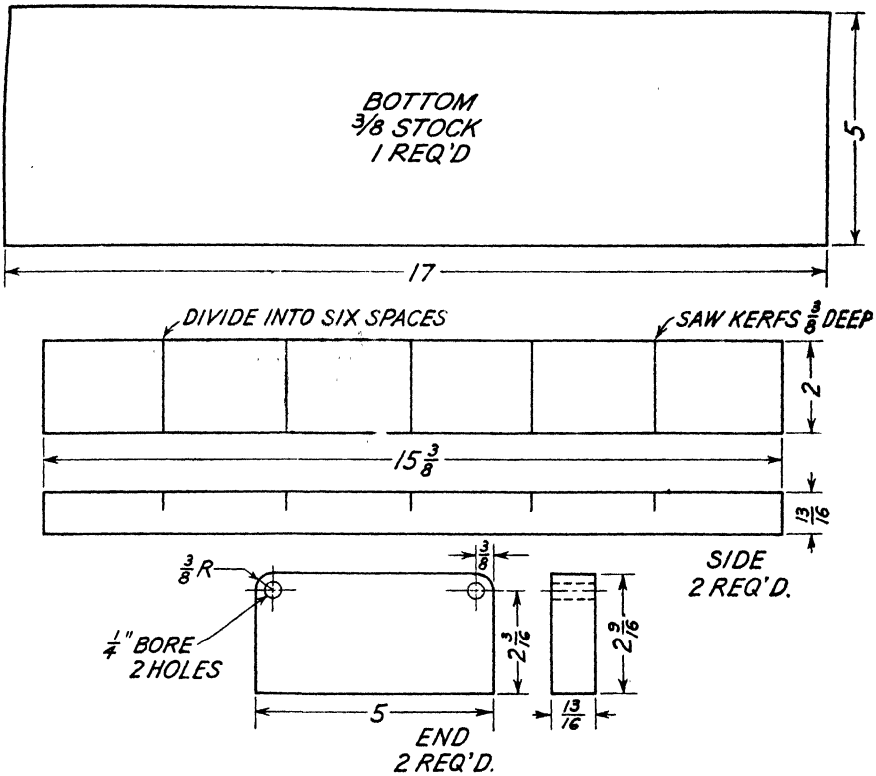
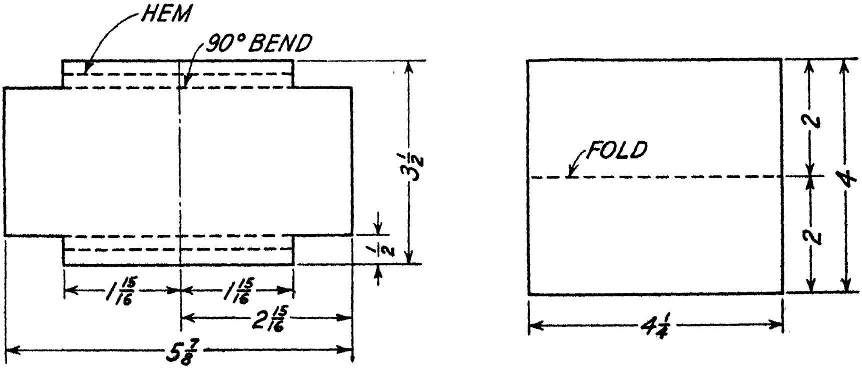


Fig. 31.



LAYOUT FOR COVER
LIGHT GAGE METAL
5 REQ'D.

LAYOUT FOR SEPARATOR
LIGHT GAGE METAL
5 REQ'D.

Fig. 32.

and the ¼-inch holes are bored through both pieces at one time.

The box should be assembled with screws because of the weight of the contents.

The separators and covers (Fig. 33) can be made from metal salvaged from old cans. The ends of the cans may be removed with a can opener. Cut the can open with tin snips at the soldered seam. A mallet may be used to flatten the metal.

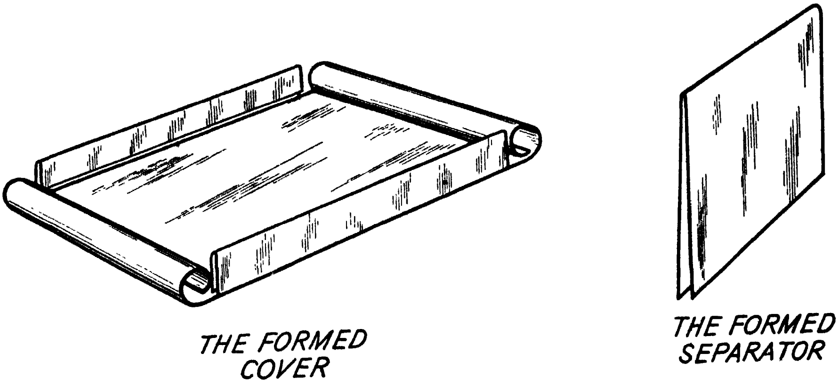


FIG. 33.

The hems and folds in the covers and separators can be formed in a vise. If the jaws of the vise are not smooth or square, clamp the metal between two blocks of wood.

The slides on the covers are formed over a ¼-inch dowel.

The box should be painted.

DESIGN VARIATIONS

The ends may be redesigned for use as handles for carrying the box. The box can be made larger, so that more compartments may be added.

TEST QUESTIONS

1. What is the procedure for squaring stock to size?
2. What determines the size of the holes for the wood screws?
3. For what is a countersink bit used?
4. How do you plan to bend the metal parts?
5. What advantage is there in using wood screws for the assembly?

9. SCRAPBOOK

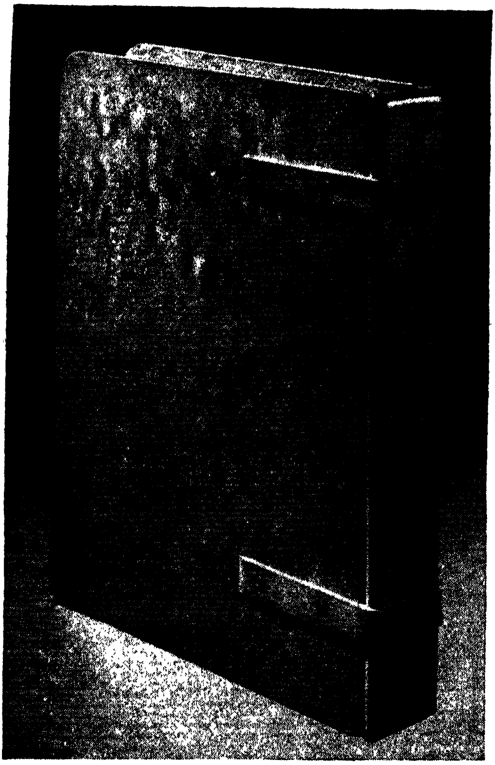
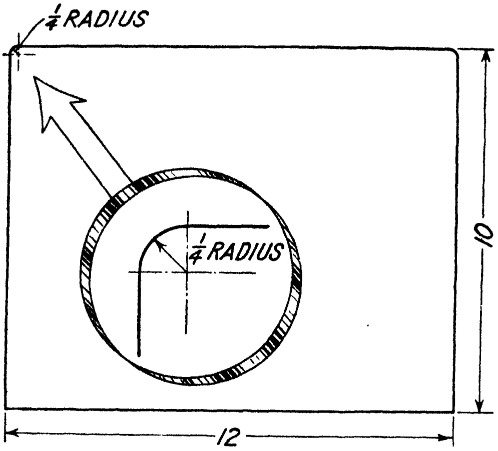


Fig. 34.

The scrapbook (Fig. 34) is a favorite project in the school shop. Clippings, pictures, school programs, and all the other papers that a student likes to save can be mounted and kept in it. By changing the size to fit the standard filler sheets, the book can be used as a photographic album.

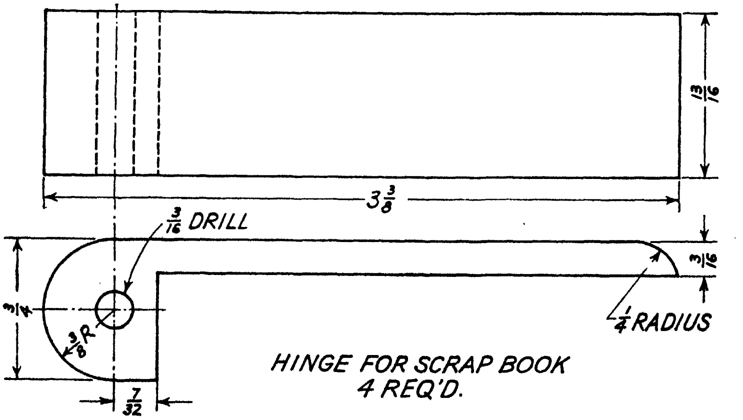
TIMESAVING HINTS

For ease in planning, the project should be divided into the following jobs:

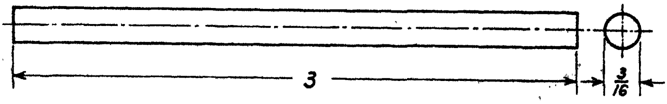


COVER
1/8 PRESDWOOD
2 REQ'D.

FIG. 35.



HINGE FOR SCRAP BOOK
4 REQ'D.



HINGE PIN
MAPLE DOWEL
4 REQ'D.

FIG. 36.

Job 1. Shape the Covers (Fig. 35).
Job 2. Shape the Hinges (Fig. 36).
Job 3. Shape the Back (Figs. 37*A* and 37*B*).
Job 4. Finish and Assemble.

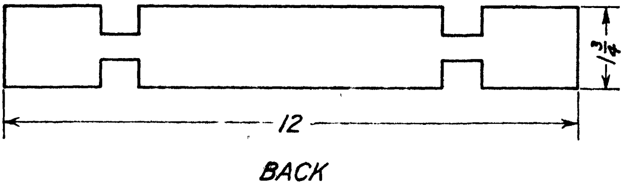


FIG. 37*A*.

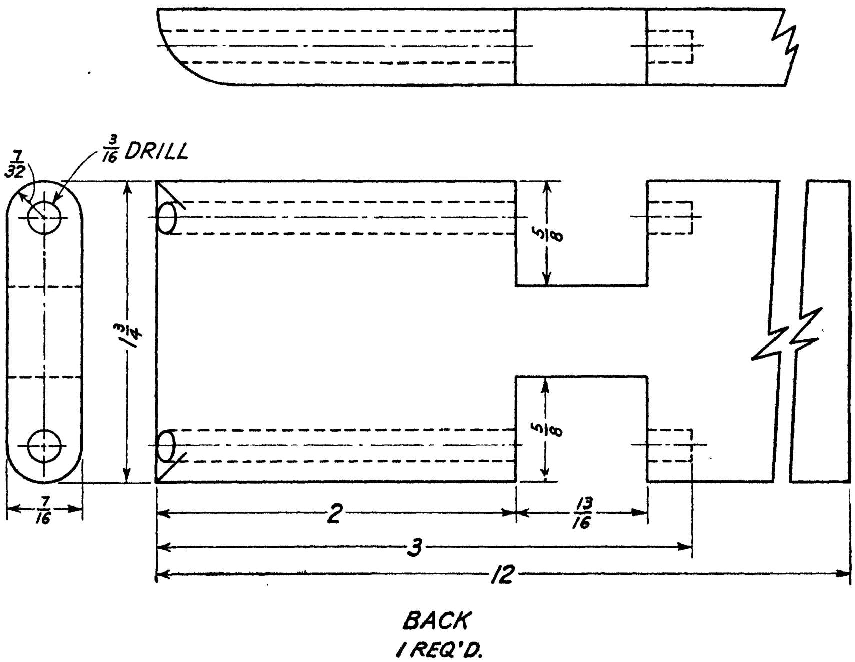


FIG. 37*B*.

The edges of the presdwood can be finished by sanding with fine sandpaper and polishing with wax. Presdwood can be secured from most lumberyards, but plywood can be used if presdwood is not available.

The hinges and the back should be made of a fine-grained wood such as red gum, maple, or birch; they can be attached to the covers with glue and split rivets. The positions of the hinges are marked on the back piece after the hinges have been attached to the covers. It is easier to sand and apply the finish to the wood hinges and covers before assembly.

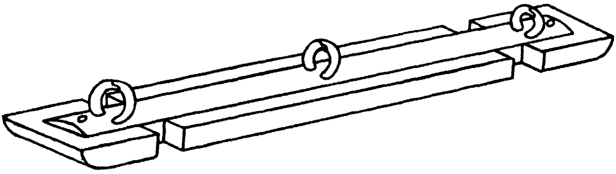


Fig. 38.

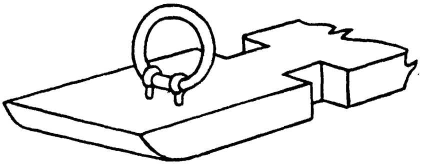


Fig. 39.

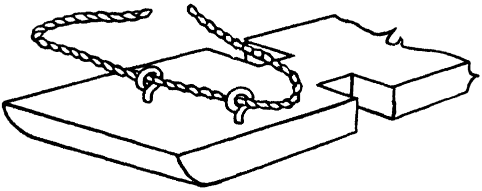


Fig. 40.

SCRAPBOOK or PHOTOGRAPHS or whatever name is to be used on the book may be cut from plywood or painted directly on the presdwood.

Several coats of wax make a satisfactory finish for the presdwood covers. If a darker color is wanted, the covers may be given a coat of linseed oil before the wax is applied.

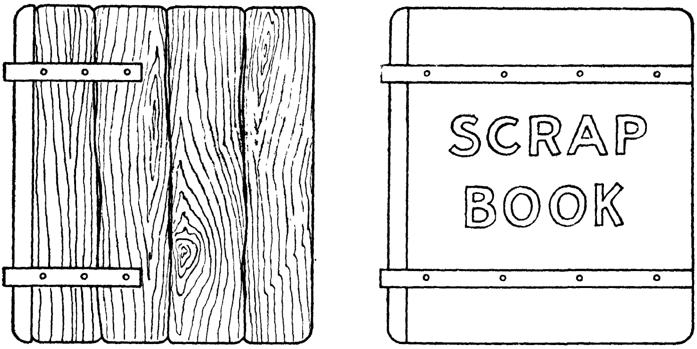
Provision for holding the paper should be made. A standard notebook ring assembly can be installed (Fig. 38).

Split notebook rings can be used and can be held in place with small screw eyes (Fig. 39).

A leather or fabric cord can be used to tie the sheets of paper in place (Fig. 40).

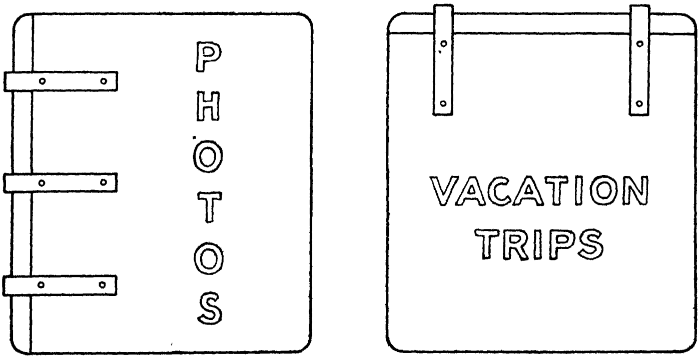
DIFFERENT DESIGNS

Other designs for the cover are given in Fig. 41.



THE COVERS CAN BE DECORATED TO RESEMBLE RUSTIC WOOD

THE HINGES MAY EXTEND ACROSS THE COVER



THREE HINGES CAN BE USED TO MAKE A STRONGER COVER

THE BOOK CAN BE MADE TO OPEN AT THE TOP

FIG. 41.

The title may be painted on the cover in color.

Letters may be cut from thin wood, presdwood, or plastic and cemented to the cover.

QUESTIONS

1. What procedure would you use to square the covers?
2. In what way does presdwood saw differently from plywood?
3. What is presdwood?
4. How far apart should the notebook rings be attached?
5. What kind and size of filler sheets are you planning to use?

10. TABLE CHRISTMAS TREE

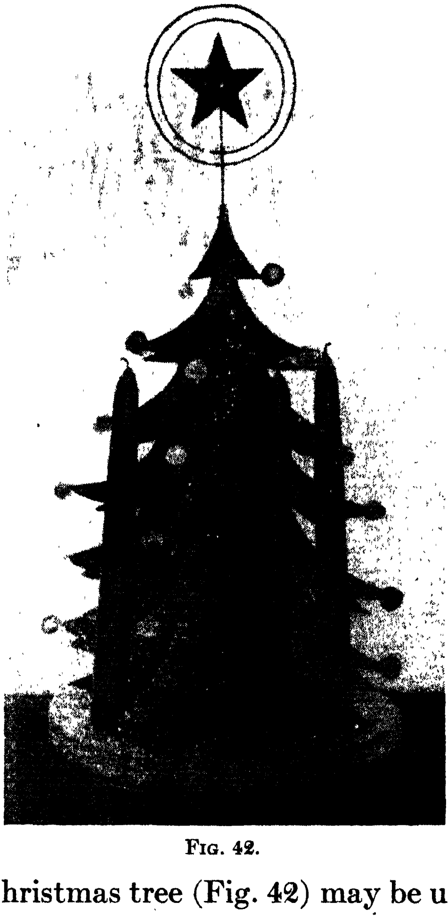


FIG. 42.

The table Christmas tree (Fig. 42) may be used as a centerpiece on the dinner table. The evergreen tree and the star are symbolic of Christmas, and the finish, candies, and candles are in keeping with the holiday spirit. Carefully made and decorated with sparkling glitter, the table Christmas tree is a welcome addition to the holiday decorations of the American home.

HELPFUL HINTS

If the project is divided into these three jobs, planning will be simplified:

Job 1. Make the Base (Fig. 43).
Job 2. Make the Tree (Fig. 44) and Assemble It.
Job 3. Decorate the Christmas Tree.

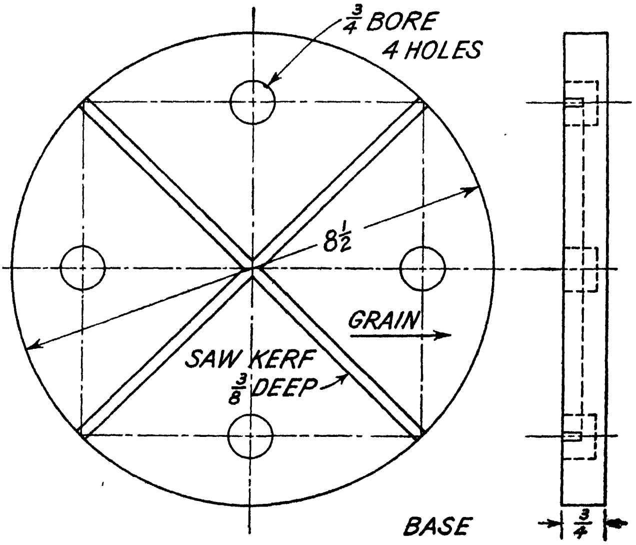


Fig. 43.

The holes in the base serve as candle receptacles and should not be bored all the way through the stock. Stop boring when the spur shows through the back.

The two trees may be cut from one-half of a standard 20 × 28-inch sheet of tin plate. The curves of the branches have been drawn so that a pair of 2-inch curved tinner's snips can be used effectively.

The star may be laid out on the sheet metal by dividing the circumference of the circle into five parts. This can be done by a trial-and-error method with a pair of dividers. The two circles of wire may be formed around any cylindrical object

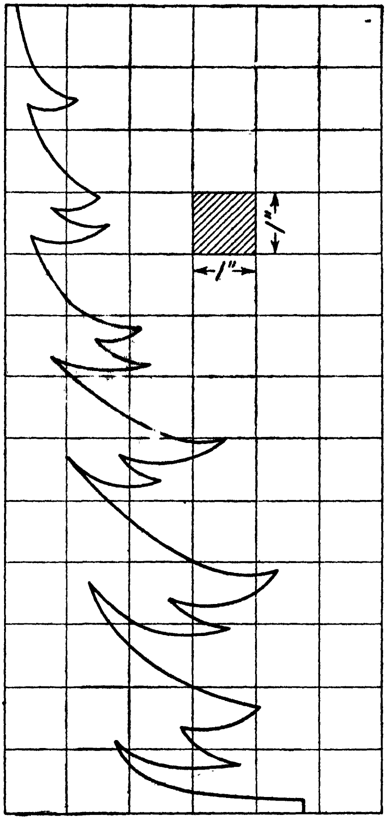


Fig. 44.

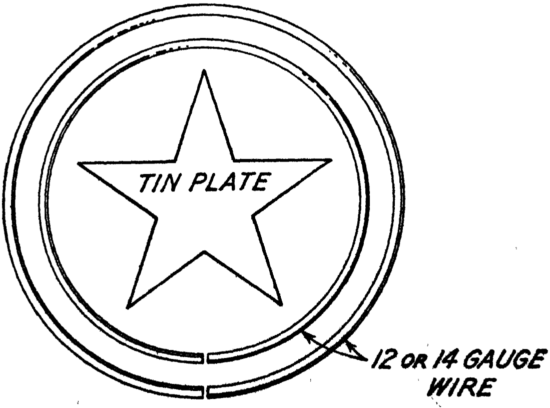


Fig. 45A.

of the approximate size shown in Fig. 45*A*. A tin can may serve the purpose. The two wire rings, the star, and the supporting wire are assembled as a unit (Fig. 45*B*). The parts may be placed in their correct position on a piece of scrap wood, held in place with nails or weights and then soldered.

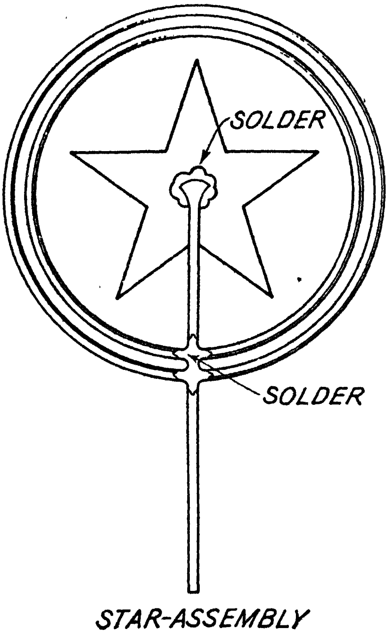


FIG. 45*B*.

Only one-half of the tree pattern is shown. The other half may be made from the same pattern. Two whole trees are required. The two trees are then joined by making two cuts as shown and slipping them together. The trees are held in the saw cuts made in the base by bending over the ears and nailing them in place (Fig. 46). The star assembly and the tops of the trees are soldered together.

The saw cuts are carefully filled with sash putty. The wood base is given a coat of shellac and allowed to dry. Enamel is brushed on the tree and base and, while they are still wet, the flitter is sprinkled on them. Care should be taken to avoid wasting the flitter.

Flitter is the trade name for the material used by sign painters. It is composed of small silvered flakes that reflect the light. Most artists' supply stores carry flitter in three grades. The medium grade is recommended for the Christmas tree.

VARIATION IN DECORATION

The size of the star on the top of the tree may be varied, and the halo rings reduced or omitted. A cross could be used in place of the star. The top of the base looks well when painted white and covered with flitter. The edge of the base is attractive when painted bright red. The star and halo make a pleasing appearance when painted white or a pale yellow. The trees themselves may be painted pale green, pink, yellow, light blue, or any color to suit your fancy. Small gumdrops of assorted colors may be stuck on the tips of the branches. Standard 10-inch candles should be placed in the holes bored in the base.

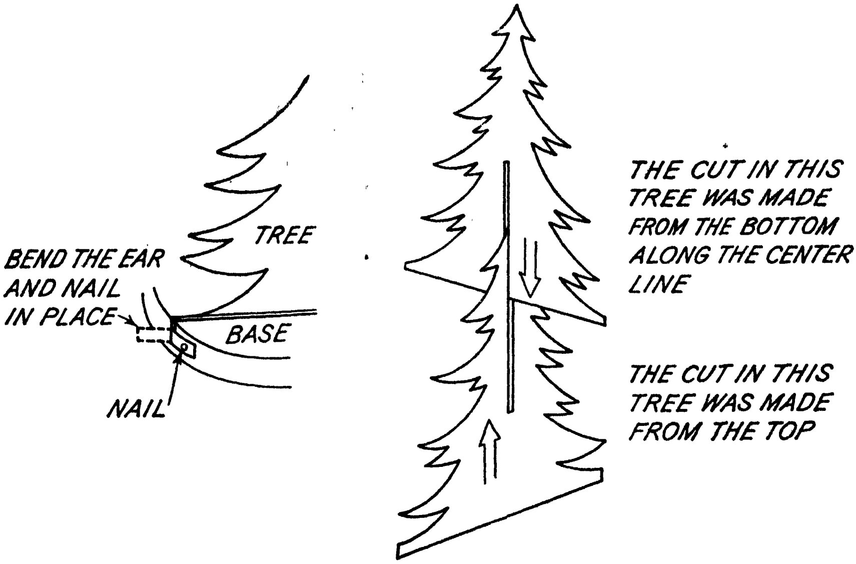

TREE
BEND THE EAR AND NAIL IN PLACE
BASE
NAIL
THE CUT IN THIS TREE WAS MADE FROM THE BOTTOM ALONG THE CENTER LINE
THE CUT IN THIS TREE WAS MADE FROM THE TOP

FIG. 46.

TEST TOPICS

1. Explain the purpose of soldering flux.
2. Describe the process of tinning a soldering copper.
3. What precautions should be observed when cutting the tree from sheet metal?
4. Describe your plan for preventing the waste of flitter.
5. Explain the reason for shellacking the base.
6. Give a procedure for enlarging a pattern by means of squares.

11. CARVED LETTER OPENER

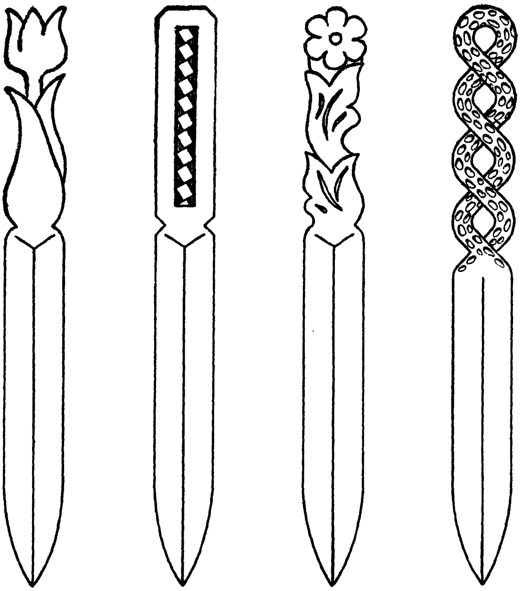
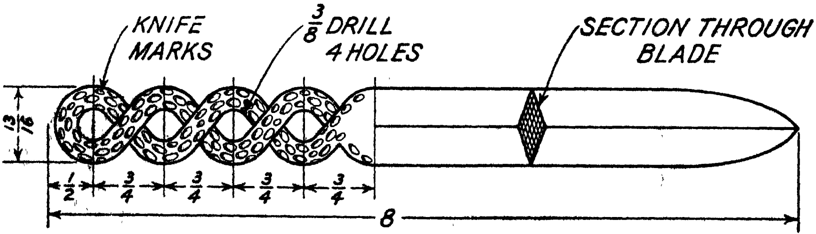


FIG. 47.

An attractive letter opener (Fig. 47) is not only handy for opening letters but makes an interesting desk ornament. Every boy likes to make a letter opener and this one (Fig. 48) is fun to carve because it looks difficult.



LETTER OPENER
5/16 GUMWOOD

FIG. 48.

HELPS

In planning your procedure for making the letter opener it will be helpful to divide the project into three jobs and plan each job separately:

Job 1. Shape the Blade.
Job 2. Carve the Handle.
Job 3. Apply the Finish.

It is advisable to make the layout for the handle and bore the holes before doing any work on the blade. Pilot holes will prevent the spur of the bit from splitting the wood.

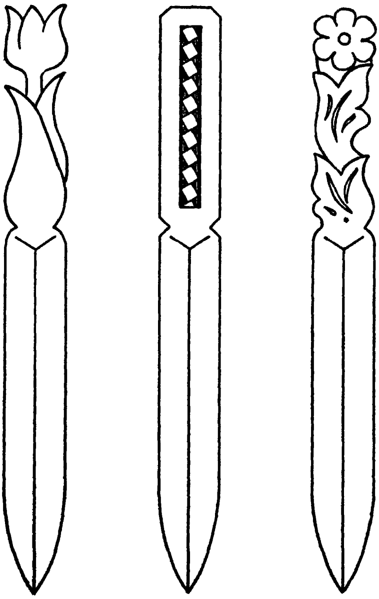


Fig. 49.

The blade is thicker at the handle than at the point. This taper is more easily cut with a block plane, although a spokeshave could be used. The blade is sharpened by planing the edges after the blade has been tapered.

A sharp knife will make clean cuts, which add to the attractiveness of the handle. The clean sharp cuts should not be sanded out because they are a part of the design.

OTHER DESIGNS

Cabinet woods such as mahogany, walnut, and red gum have grain patterns that add to the attractiveness of the letter opener and are easy to carve. Use any of the wood finishes that will bring out the beauty of the grain.

Using the same proportions, the handle may be varied. Any number of designs are possible (Fig. 49).

QUESTIONS

1. How do you sharpen pocket or carving knives?
2. What number auger bit would be used to bore a $\frac{3}{8}$-inch hole?
3. How do you prevent the wood from splitting when you bore the holes in the handle?
4. What is the difference between a taper and a bevel?
5. Name two transparent finishing materials.

12. THREE-IN-A-ROW GAME

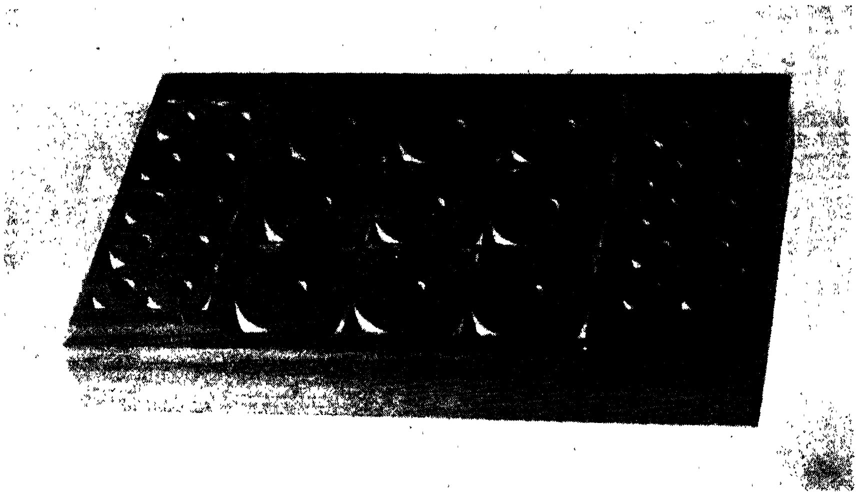


Fig. 50.

This board (Fig. 50) provides a new way to play an old game. Each player has five pegs to place in the center holes and one scoring peg. The end holes are used for scoring. Playing in turn, the first player to place three pegs in a row wins the game. Most students will recognize this game as tick-tack-toe. Several of these game boards would be a desirable addition to your indoor game equipment.

HELPFUL SUGGESTIONS

In planning it will be helpful to divide this project into two jobs:

Job 1. Make the Game Board.

Job 2. Decorate and Apply the Finish.

This game board presents an opportunity for decorating the surface with chip carving. If you plan to carve the surface, you should select a close-grained wood such as red gum.

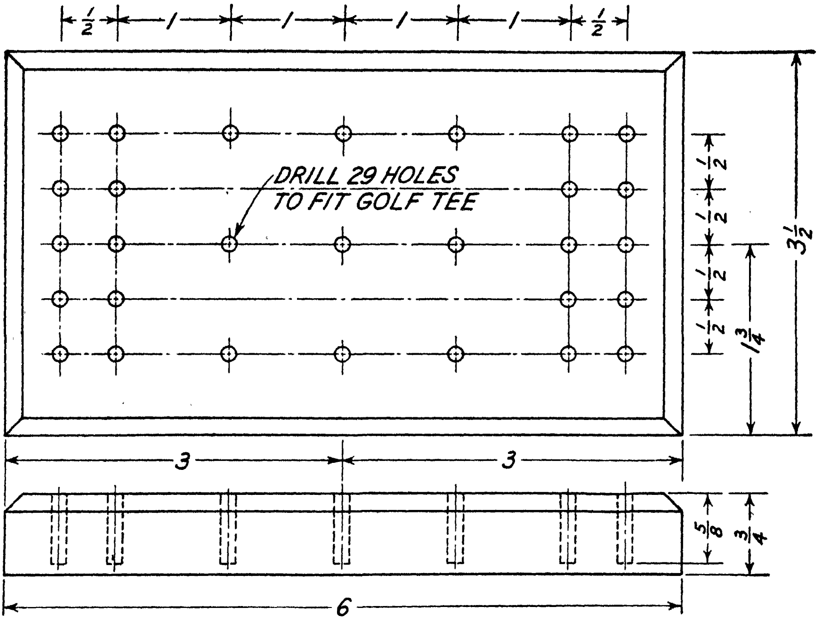


Fig. 51.

In order to drill all holes to the correct depth shown in Fig. 51, it will be helpful to use a depth gage. If a commercial gage is not available, a substitute may be easily made by drilling a hole in a small block of wood. The distance that the drill projects outside the piece of wood should be equal to the depth of the hole (Fig. 52).

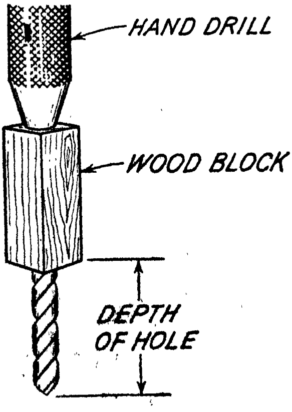


Fig. 52.

Colored golf tees may be used as pegs. Drill the holes the correct size for the tees that you intend to use. To distinguish the pegs of each player, paint the tops of each set of pegs a different color.

The holes for scoring may be numbered with pen and ink or with steel stamps.

Any of the wood finishes that bring out the beauty of the grain can be used.

DESIGN HELPS

Fine cabinet woods such as mahogany and walnut have grain patterns that will give a different appearance to your job.

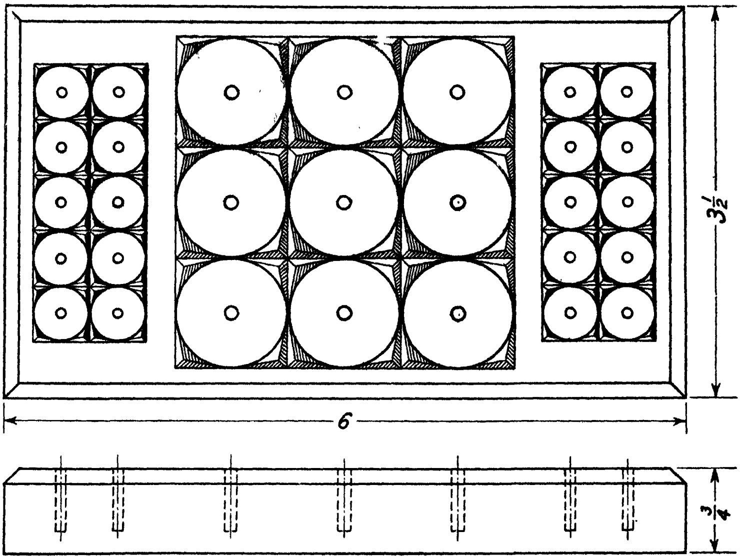


Fig. 53.

The surface may be decorated with chip carving. One of the many possible geometrical designs is illustrated in Fig. 53.

TEST YOURSELF

1. When drilling duplicate holes with a hand drill, what device may be used to control the depth of the hole?
2. Draw small sketches illustrating the difference between a bevel and a chamfer.
3. List two finishing materials that will bring out the grain.
4. What three common marking systems are used to indicate the sizes of straight-shank drills?
5. What material is used to thin varnish that is too thick to brush easily?

13. SOLITAIRE GAME

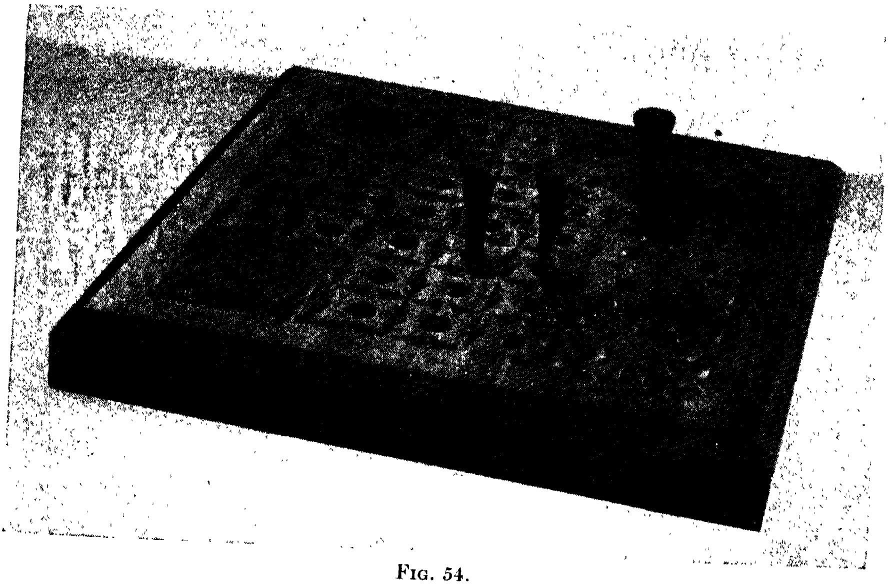


FIG. 54.

Those who like puzzles will enjoy playing this solitaire game (Fig. 54). It is to be played by one person and is especially fine for convalescents. The game board is easy to make, and the directions for playing the game are quickly learned.

To begin, pegs are placed in all except the center hole. They are removed by jumping as in checkers. The peg that has been jumped over is removed from the board. The purpose of the game is to eliminate all but one peg which should be in the center hole at the completion of the last jump. Diagonal jumps are not permitted.

SUGGESTIONS

When planning the solitaire game board it will be helpful to divide the work into two jobs:

Job 1. Make the Game Board.

Job 2. Decorate and Apply the Finish.

This game board is ideal for chip carving and, if you intend to carve it, select a close-grained wood such as red gum.

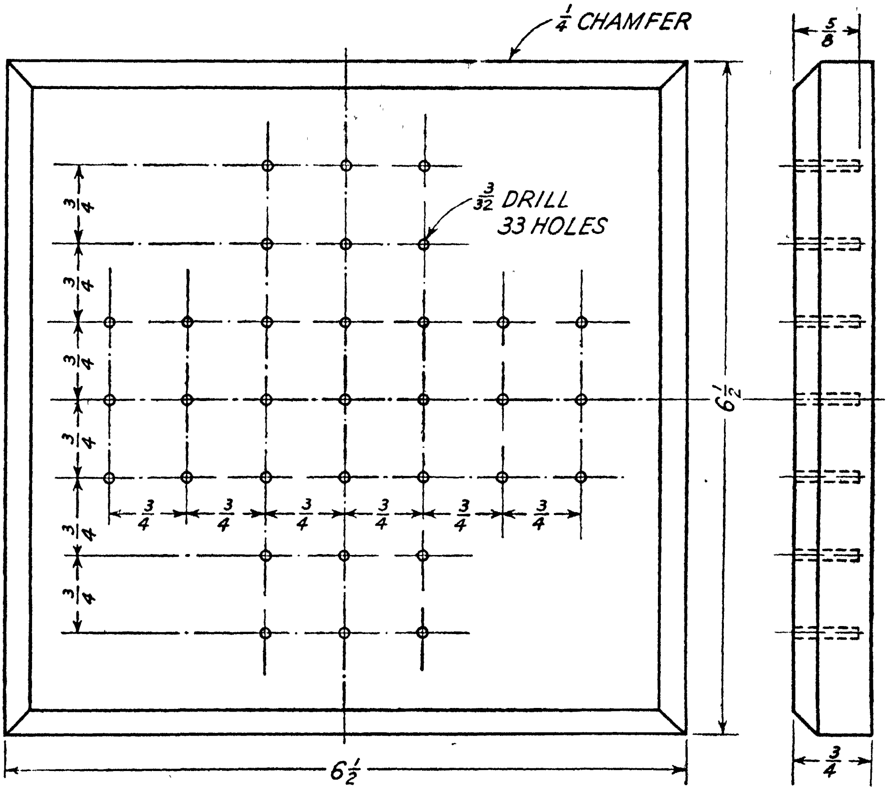


FIG. 55.

In order to drill all holes to the depth shown in Fig. 55 it will be helpful to use a depth gage. If a commercial gage is not available, a substitute may be made by drilling a hole in a small block of wood. The distance that the drill projects outside the piece of wood should be equal to the depth of the hole (Fig. 56).

Golf tees may be used as pegs. Drill the holes to fit.

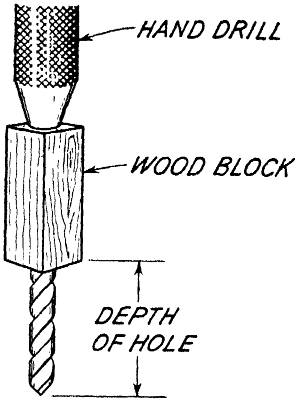


FIG. 56.

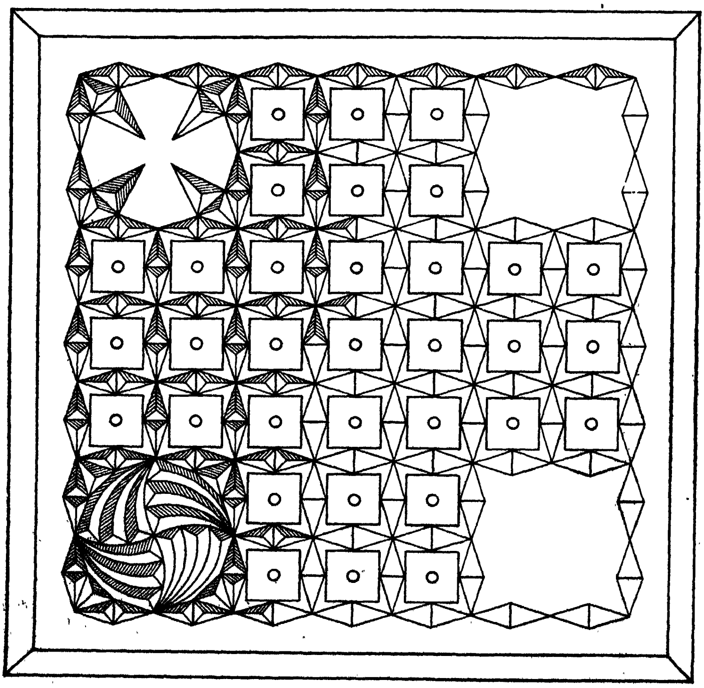


FIG. 57.

A wood finish that brings out the beauty of the grain should be used.

SUGGESTED DESIGN

Fine cabinet woods such as mahogany and walnut have grain patterns that give an interesting appearance to your project.

The surface may be decorated with chip carving. One of the many possible geometrical designs is illustrated in Fig. 57.

QUIZ

1. How can you make a depth gage for a drill?
2. What method is used to draw the lines for laying out a chamfer?
3. Why should a transparent finish be used on fine cabinet woods?
4. What tool is used to hold a straight-shank drill bit?
5. What solvent is used to clean a varnish brush?

14. BEACH SANDALS

Fig. 58.

Beach sandals (Fig. 58) are wooden soles that are held on the feet with straps. They protect your feet from stones; they enable you to reach the dressing room with clean feet; and they are recommended for use in the locker room.

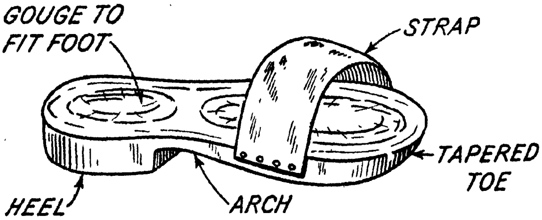


Fig. 59.

SUGGESTIONS THAT HELP

This project can be easily planned as two jobs:

Job 1. Lay Out and Shape the Sandals (Fig. 59).
Job 2. Apply the Finish and Attach the Straps.

Layouts for the patterns of the sandals can be made by tracing around a shoe that has a leather sole. Tennis shoes cannot be used for tracing the patterns because the soles are oversize and are not correctly shaped.

It will be easier to gouge the sandals before the outline shape is cut, because the wood can be held more securely in the vise. The top of the sandal should be shaped to fit the bottom of your foot. This can be done with a gouge and a modelmaker's plane or spokeshave. The sandals can be cut out by hand but if a jig saw or band saw is available, either can be used.

The size of the heel can be obtained from the leather shoes. The arch in the bottom of the sandal can be made by cutting a saw kerf with a backsaw and then removing the excess stock with a flat wood chisel.

The bottom of the toe of the sandal should be tapered to make walking easier.

A finish can be applied to the beach sandals by rubbing in several coats of linseed oil.

Canvas, elastic, or upholstering webbing can be used for the straps. The straps should be fastened to the sandals with copper-coated staples or tacks.

VARIATIONS AND DECORATIONS

The arrangement of the straps can be varied. The sandal shown in Fig. 60 may suggest other variations to you.

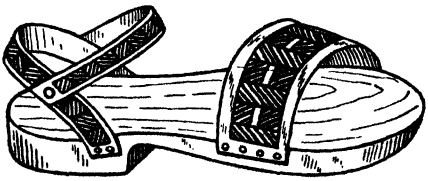


Fig. 60.

The edges of the sandals can be painted a bright color to harmonize with the straps. The straps can also be decorated with oil-paint designs.

QUESTIONS TO BE ANSWERED

1. What is the rough size of the stock required to make the sandals?

2. What material do you plan to use for straps and where can it be obtained?

3. What tools would you use to shape the top of the sandal?

4. How should you dispose of a rag that has been used to apply linseed oil?

5. If copper-coated tacks or staples are not available, what other kind of coating will prevent rust?

15. MODEL MIDGET RACER

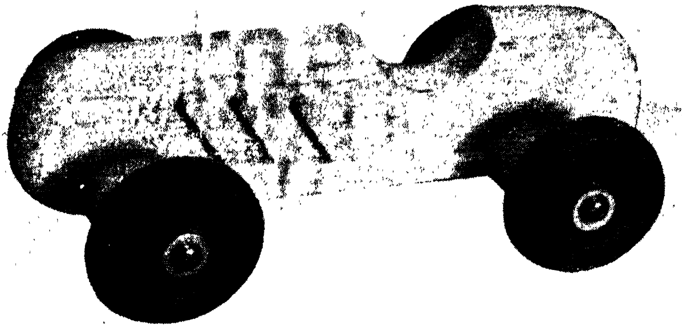


FIG. 61.

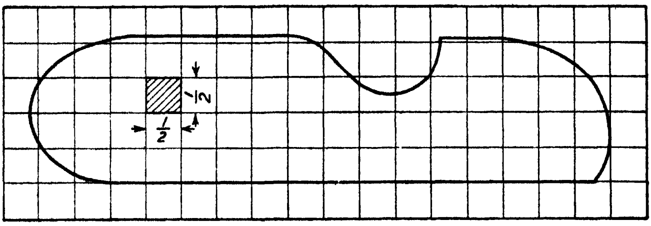
This model racer (Fig. 61), equipped with exhaust pipes, is a substantial toy that is a great deal of fun to make. The body is easily shaped with hand tools, and the basic design permits many variations. Older boys use the racer as a display piece for their room.

HINTS THAT HELP

Planning is made easier by dividing the model racer into several jobs and then planning each job separately.

Job 1. *Shape the Body*

The outline for the body can be laid out by the proportionate square method (Fig. 62). Keep the blade of the coping saw at right angles to the surface when cutting the door opening. The top, radiator, and back of the body may be rounded with a spokeshave. Thorough sanding will remove all tool marks and scratches that would later show through the paint job.

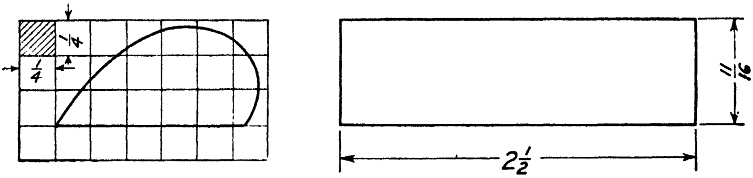


BODY

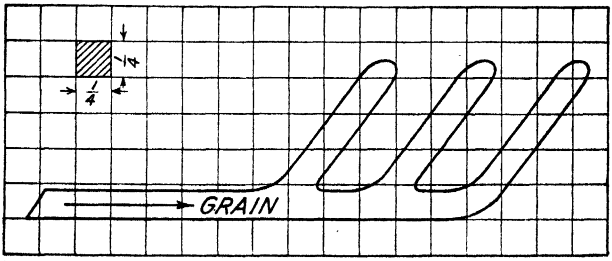
Fig. 62.

Job 2. Shape the Axles and Exhaust Pipes

The contour of the axle can be laid out on cardboard by the proportionate square method (Fig. 63) and then traced on each end of the axle block. Both axles can be made as one piece and sawed in half. The axle can be held in a vise when planing it to the line (Fig. 64).



AXLE
2 REQ'D.



EXHAUST PIPES
1/4 STOCK — 2 REQ'D.

Fig. 63.

The axle was designed to be used with 2-inch wheels. If you are unable to purchase wheels from a model supply store, use wheels salvaged from an old toy. Although wheels made by toy manufacturers are best, satisfactory ones can be sawed out of ½-inch hardwood.

The wheels can be mounted without difficulty when the ends of the axles are exactly square. Thorough sanding prepares the surfaces of the axles for a fine paint job.

Sawing the exhaust pipes carefully with a fine-toothed saw will make sanding unnecessary. The direction of the grain weakens the vertical pipes, and they may break off if you sand them carelessly.

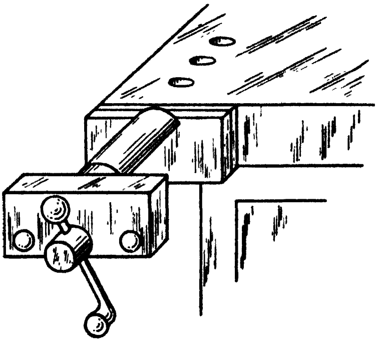


FIG. 64.

Job 3. *Assemble the Racer*

The position of the axles is shown in Fig. 65.

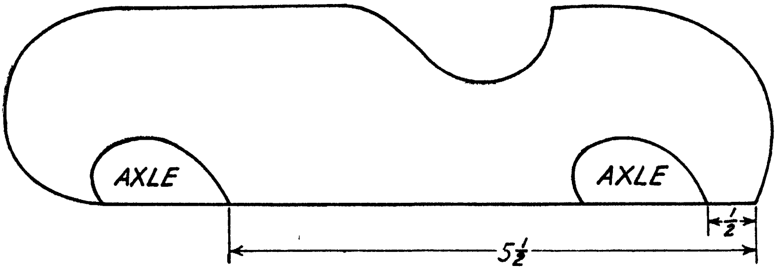


FIG. 65.

The contour of the axle may be traced with a sharp pencil. Saw in the waste stock when removing the wood with a coping saw. The axle may be fitted to the body by sanding with a piece of sandpaper wrapped around the axle block (Fig. 66).

The axles may be held in position with a 1½-inch No. 10 flathead wood screw. When the holes for the screws are drilled at a slight angle, the screw wedges the axle into the body. The

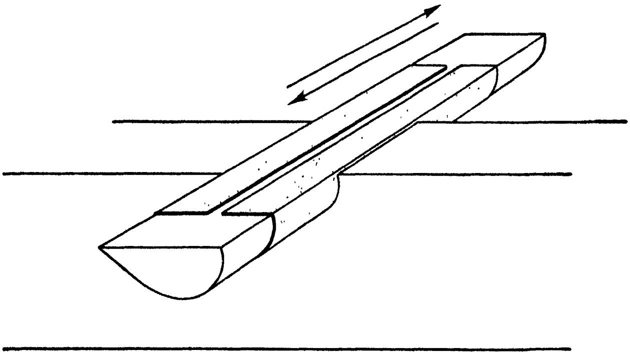


Fig. 66.

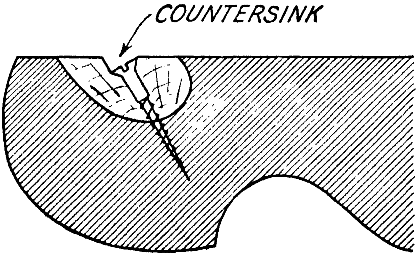
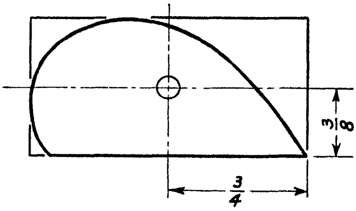


Fig. 67.



LOCATION OF HOLE FOR WHEEL SCREW

Fig. 68.

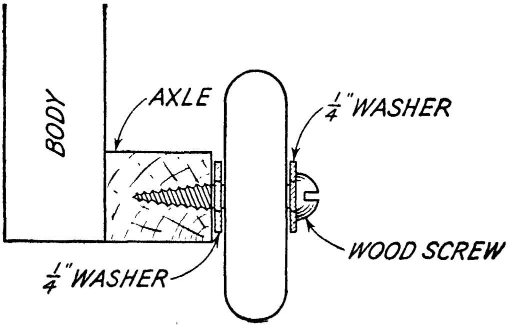


Fig. 69.

axles should extend out the same distance on both sides of the body. Countersink the wood screws (Fig. 67) so that the bottom of the axles can be planed off to make a perfect fit.

The centers for the wheels should be located accurately, so that all four wheels will ride on the ground. A pilot hole should be drilled for a 1¼ No.10 roundheaded bright wood screw (Fig. 68). The wheels will run freely if two ¼-inch iron washers are used (Fig. 69).

Glue will hold the two sets of exhaust pipes in place and make it unnecessary to use nails.

Job 4. Apply the Finish to the Racer

Most students like to enamel their racers in bright colors. The exhaust pipes look well if they are finished with aluminum or bronze paint. A light gray paint gives the tires the appearance of rubber. The body of the racer may be suspended from a screw hook to dry. Coat-hanger wire may be bent to form a hook on which to hang the wheels (Fig. 70). A good finish may be secured with two coats of enamel if the first coat is sanded with a piece of worn sandpaper.

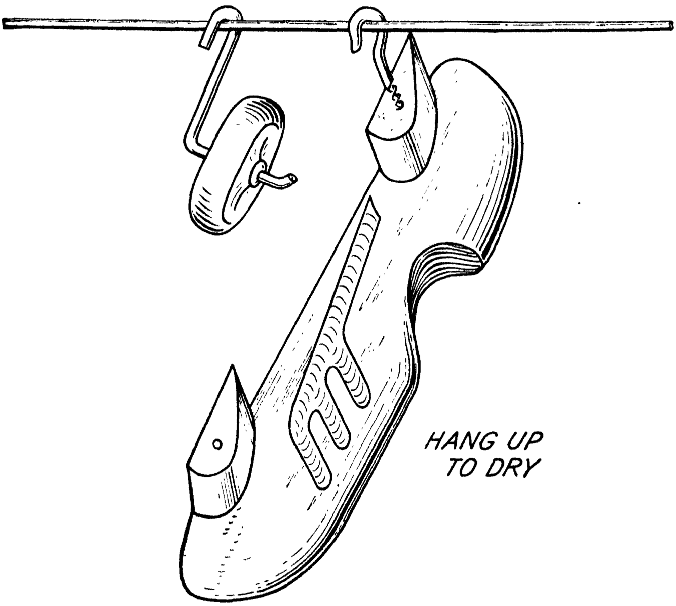


FIG. 70.

OTHER IDEAS

A celluloid windshield may be added (Fig. 71). The sharp edges of the celluloid can be removed with fine sandpaper.

The design of the front end or the radiator may be changed, and a bumper added (Fig. 72).

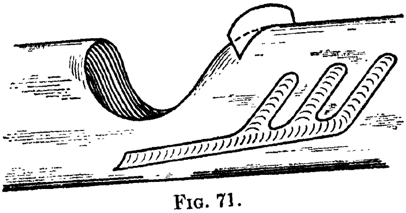


FIG. 71.

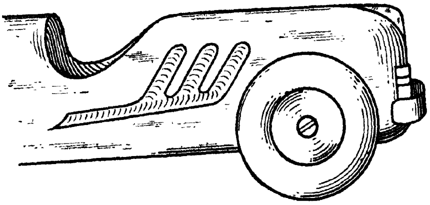


FIG. 72.

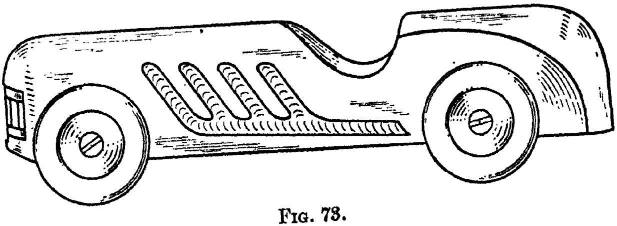


FIG. 73.

The length of the car may be increased, and the rear end shaped like a streamlined fin (Fig. 73).

QUESTIONS

1. Should wood be sanded with or across the grain?
2. Where do you intend to secure the wheels?
3. Toward which end of the saw frame should the teeth of a coping saw blade point?
4. What can be done to prevent the wood screws on the left side of the racer from becoming loose when the wheels are turned?
5. What are the dimensions of the rough stock for the body of the racer?

16. BLITZ BUGGY

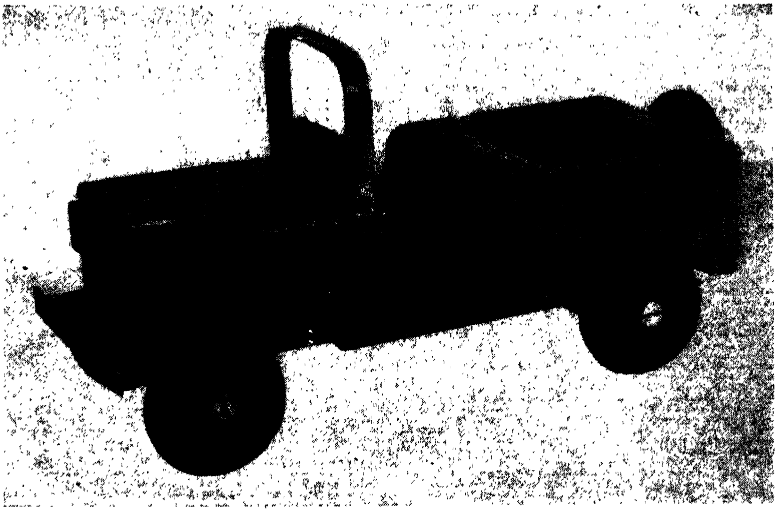


FIG. 74.

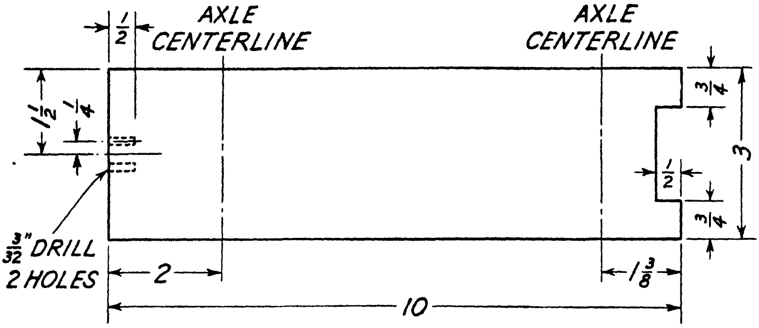
The blitz buggy (Fig. 74) is a sturdily built car just like the large ones used by the army; both of these cars were designed to withstand rough treatment. The blitz buggy will make an excellent present for a younger brother or sister and is profitable to make because comparable toys are expensive.

The blitz buggy may look difficult to you, but it is made of a number of similar parts each of which is easy to make.

HINTS ON CONSTRUCTION

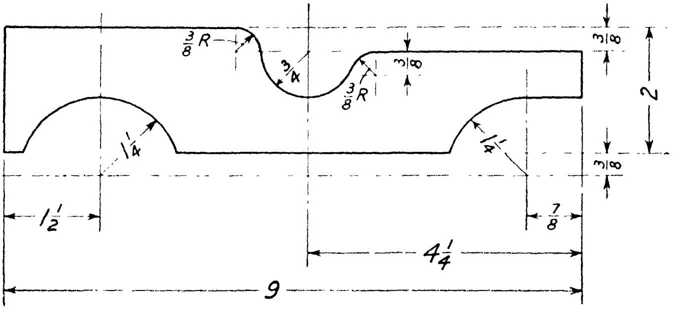
When preparing the plan for making the blitz buggy it will be helpful to divide the project into a number of jobs and to plan each job separately.

Job 1. Shape the Bottom (Fig. 75).
Job 2. Shape the Two Sides (Fig. 76).
Job 3. Shape the Dash Panel (Fig. 77).
Job 4. Make Two Seats (Fig. 78).



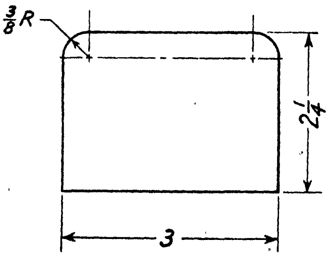
BOTTOM
7/16 STOCK - 1 REQ'D.

FIG. 75.



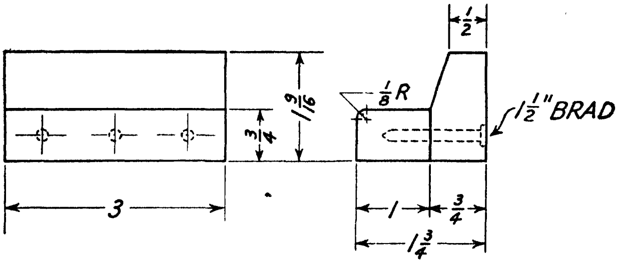
SIDE
7/16 STOCK - 2 REQ'D

FIG. 76.



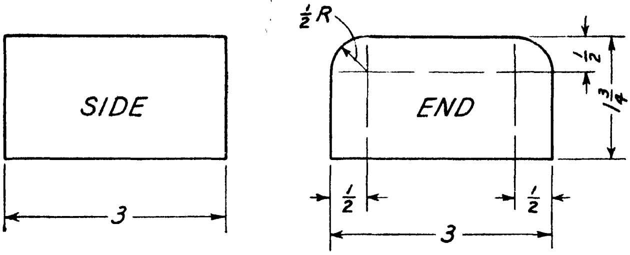
DASH PANEL
7/16 STOCK - 1 REQ'D.

FIG. 77.



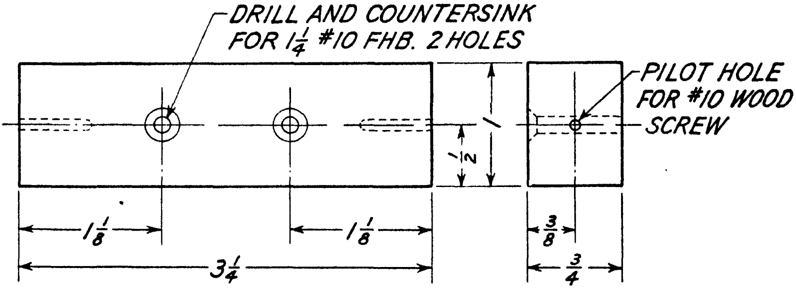
SEAT-2 REQ'D.

Fig. 78.



MOTOR BLOCK
1 REQ'D.

Fig. 79.


DRILL AND COUNTERSINK FOR 1 1/4 #10 FHB. 2 HOLES
PILOT HOLE FOR #10 WOOD SCREW
1
1/2
1 1/8
1 1/8
3 1/4
3/8
3/4

AXLE BLOCK
2 REQ'D.

Fig. 80.

Job 5. Shape the Motor Block (Fig. 79).

Job 6. Shape Two Axle Blocks (Fig. 80).

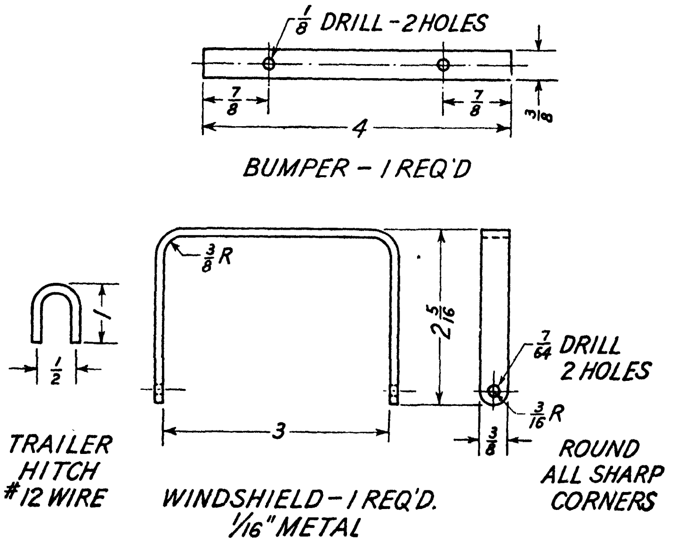
Job 7. Make the Metal Parts (Fig. 81).

Job 8. Assemble and Apply the Finish.

To make the two side pieces, it is best to square the stock to size before drawing the layout. The centers for the wheel housings are off the stock. They can be located on another piece of wood placed against the edge of the side piece.

The seats can be made in one piece and then cut to length. The pieces are assembled with glue and 1½-inch wire nails.

The axle blocks can also be made in one piece and then cut to length. The holes for the screws that hold the wheels should be drilled before the axle blocks are assembled to the blitz buggy. The centers for these holes should be carefully located so that all four wheels will ride on the ground.



BUMPER - 1 REQ'D

TRAILER HITCH #12 WIRE

WINDSHIELD - 1 REQ'D. 1/16" METAL

Fig. 81.

Wheels 2 inches in diameter should be used. If you cannot obtain ready-made ones, make them yourself or use wheels from a discarded toy.

The dash panel can be used as a form for bending the windshield frame.

All wooden parts should be carefully sanded before the assembly.

In assembling the parts, this procedure is advised:

1. Nail the dash panel to the motor block.
2. Nail the bottom to the motor block.
3. Nail the sides in place.
4. Locate and nail the seats in place.
5. Assemble the axle blocks with screws.
6. Attach metal parts.
7. Attach the wheels.

The wheels should be removed to apply the finish. The olive-drab color used on army equipment can be obtained by mixing various colors of paint. You will need to experiment with your paint to obtain the desired color. Two colors most likely to approach olive drab when mixed are yellow and blue. The wheels look best when painted black.

ANSWER THESE QUESTIONS

1. How would you lay out an arc of a circle when the center is not on the piece of wood?
2. If you allow ¾ inch for cutting, what should be the length of the stock out of which the axle blocks are cut?
3. What could be done after the trial assembly if all the wheels did not touch the ground?
4. What kind of metal do you plan to use for the metal parts?
5. If the olive-drab paint that you mix is too thick, what material can be used for thinning?
6. Where do you plan to secure the wheels for this project?

17. BLITZ-BUGGY TRAILER

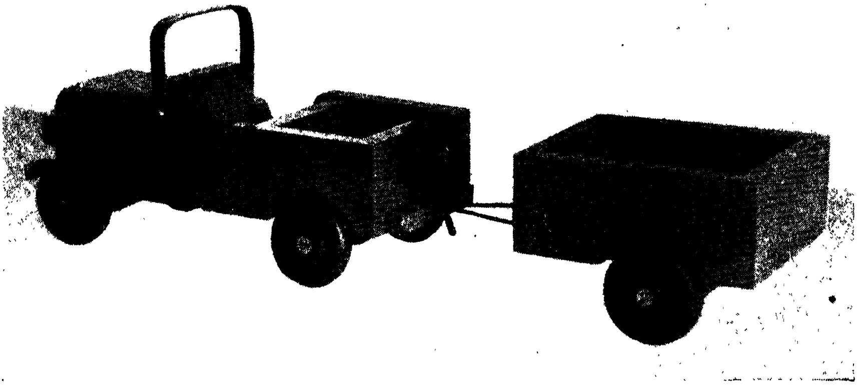


FIG. 82.

The blitz-buggy trailer (Fig. 82) is ruggedly built like its motor unit, and adds to the interest and enjoyment of the toy. Youngsters enjoy hauling playthings with the blitz buggy and trailer.

The division of the project into the following jobs will simplify the planning:

Job 1. Shape the Bottom (Fig. 83).
Job 2. Shape the Two Sides (Fig. 84).
Job 3. Shape the Ends (Fig. 85).
Job 4. Shape the Axle Block (Fig. 86).
Job 5. Bend the Trailer Hitch (Fig. 87).
Job 6. Assemble and Paint.

In making the two sides, it is best to square the stock to size before laying out the wheel housing. The center for the wheel housing is off the stock but it can be located on another piece of wood placed against the edge of the side piece.

The holes for the screws that hold on the wheels should be drilled before the axle block is assembled to the trailer.

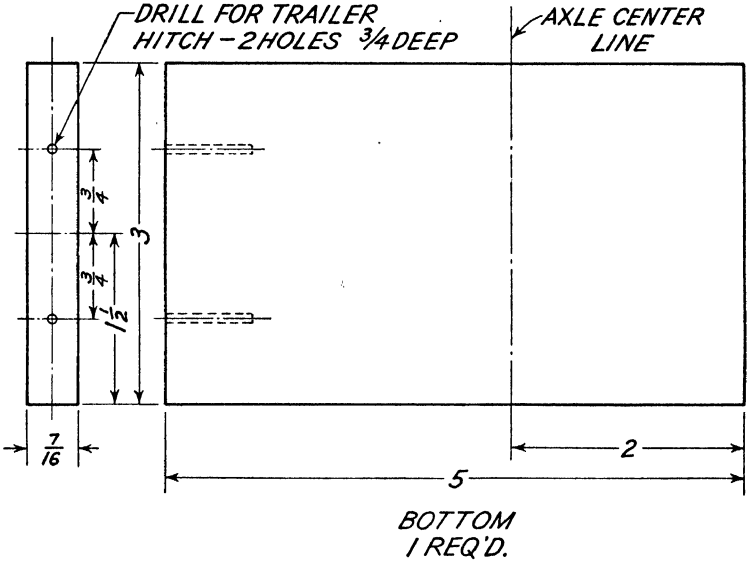


FIG. 83.

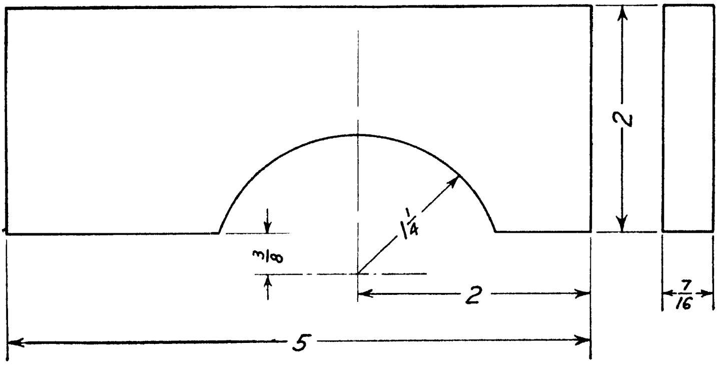
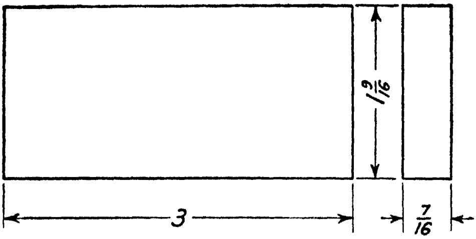


FIG. 84.

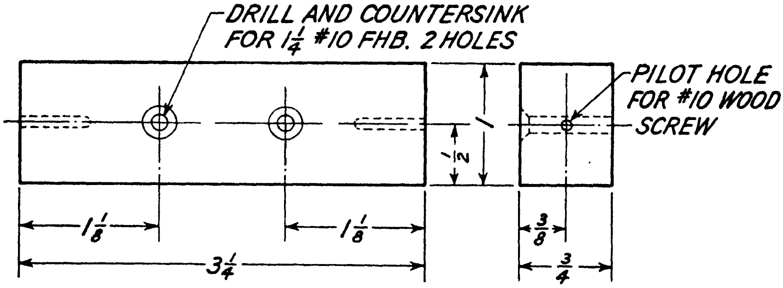
All parts should be carefully sanded before assembly.

A piece of wire from a coat hanger is used for the trailer hitch. When the hitch is assembled to the trailer, holes of the



END - 2 REQ'D

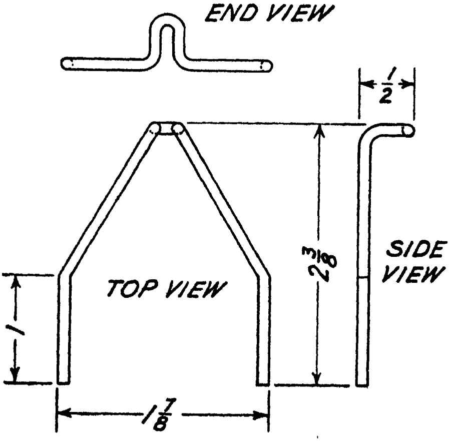
FIG. 85.



DRILL AND COUNTERSINK FOR $1\frac{1}{4}$ #10 FHB. 2 HOLES
PILOT HOLE FOR #10 WOOD SCREW
1
$\frac{1}{2}$
$1\frac{1}{8}$
$1\frac{1}{8}$
$3\frac{1}{4}$
$\frac{3}{8}$
$\frac{3}{4}$

AXLE BLOCK
2 REQ'D.

FIG. 86.



TRAILER HITCH
#12 WIRE - 1 REQ'D.

FIG. 87.

correct size must be drilled carefully to prevent splitting the wood.

The paint job will be much neater if the wheels are removed for painting. The wheels look best when painted black.

BE SURE YOU CAN ANSWER THESE

1. What size hole should be drilled for the shank of a No.10 wood screw?
2. What size brads should be used to assemble the trailer?
3. What is the difference between counterboring and countersinking?
4. What are the differences between a twist drill bit and a twist drill?

18. FREIGHT TRUCK

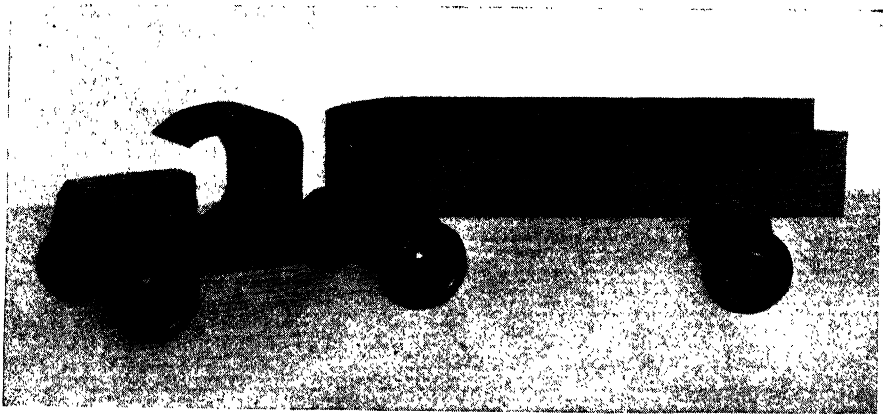


FIG. 88.

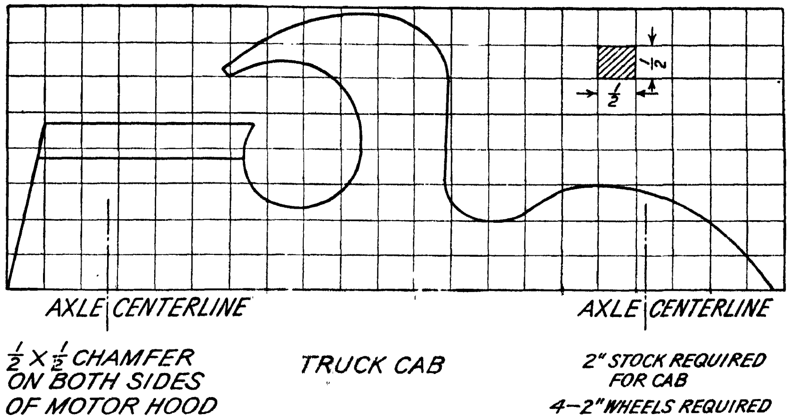
The freight truck (Fig. 88) looks like one of the large commercial hauling trucks and has a semitrailer into which toys and building blocks can be loaded. A younger brother or sister would enjoy having one, for it is an excellent toy.

HINTS ON CONSTRUCTION

When preparing your plan of work it will be helpful to divide the project into the following jobs and then plan each job separately:

Job 1. Make the Truck Cab (Fig. 89).
Job 2. Make the Axle Blocks (Fig. 90).
Job 3. Assemble the Truck.
Job 4. Make the Trailer Bottom (Fig. 91).
Job 5. Make the Trailer Axle Block (Fig. 92).
Job 6. Make the Trailer Sides (Fig. 93).
Job 7. Assemble the Trailer.
Job 8. Apply Enamel to the Truck and Trailer.

FREIGHT TRUCK



$\frac{1}{2}$
$\frac{1}{2}$
AXLE CENTERLINE
AXLE CENTERLINE
$\frac{1}{2}$ X $\frac{1}{2}$ CHAMFER ON BOTH SIDES OF MOTOR HOOD
TRUCK CAB
2" STOCK REQUIRED FOR CAB
4–2" WHEELS REQUIRED

Fig. 89.

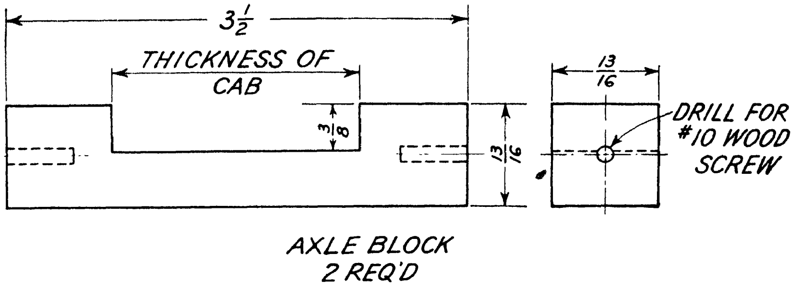


Fig. 90.

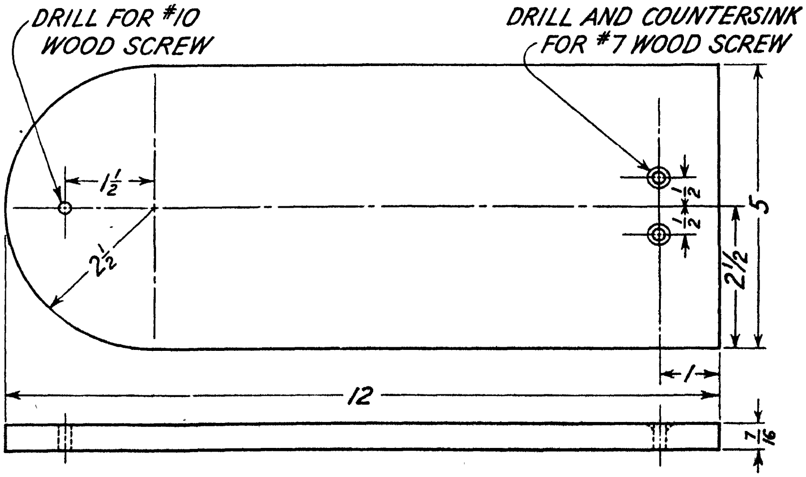


Fig. 91.

The truck cab should be sawed from a piece of clear white pine. It is possible to saw the cab out by hand but if a jig saw or band saw is available, either can be used.

Care should be taken in making the axle blocks so that, when they are assembled to the cab, all the wheels will ride on the ground. If glue is used with the nails in fastening the axle blocks to the cab, the joint will be stronger.

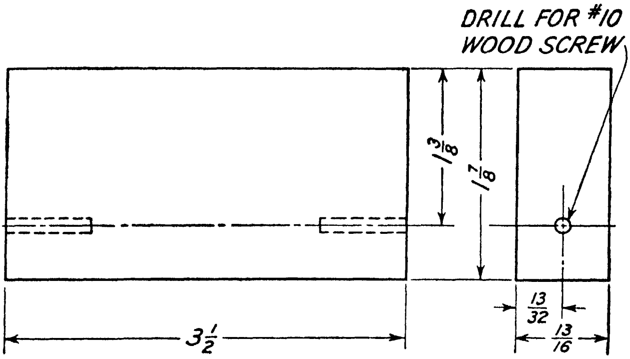


FIG. 92.

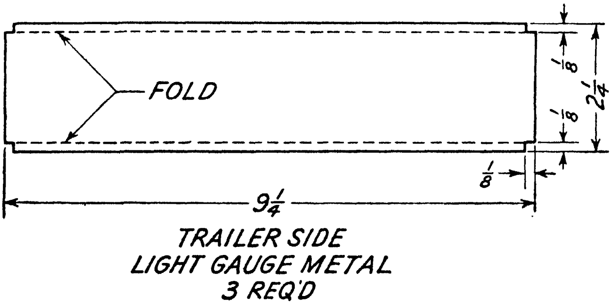


FIG. 93.

Material for the trailer sides can be obtained from discarded metal cans. A bar folder can be used to fold the hems on the trailer sides. If this machine is not available, the metal can be clamped between two pieces of wood or iron (Fig. 94). If material of the correct length can be obtained, the trailer sides can be made of one piece. If the trailer sides are made in three pieces, only one end of two of the pieces is hemmed. The pieces are soldered together after they are nailed to the trailer bottom (Fig. 95).

Wheels for the truck can be obtained from discarded toys or they can be purchased from a store handling model supplies. The wheels should be painted before they are fastened to the truck and trailer.

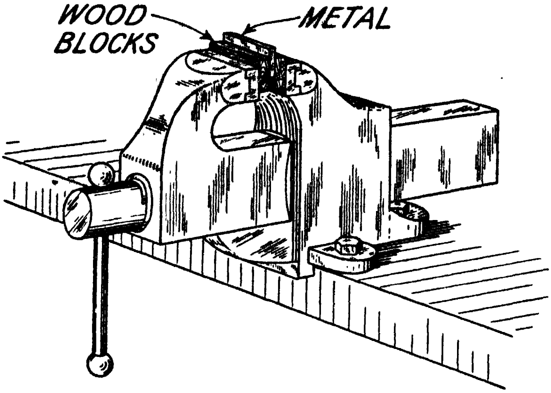


FIG. 94.

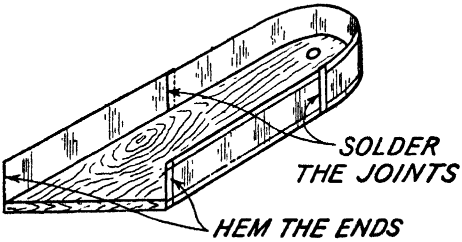


FIG. 95.

It is best to apply the enamel finish to the truck and trailer at the same time.

DESIGN VARIATIONS

The trailer sides can be made higher and a wooden roof installed to convert the trailer into a closed moving van (Fig. 96).

A trailer hitch can be designed to haul additional trailers (Fig. 97).

An oil-tank trailer can be designed by using a large metal can (Fig. 98).

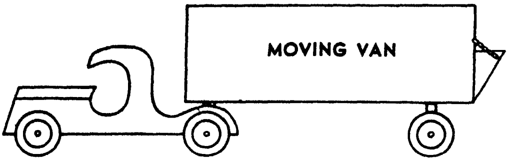


Fig. 96.

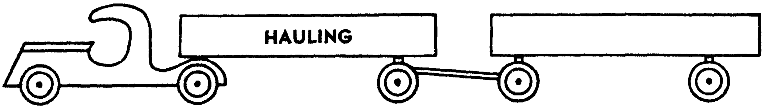


Fig. 97.

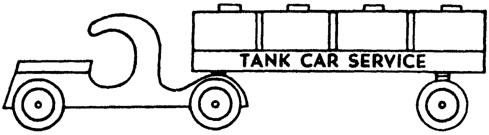


Fig. 98.

CAN YOU ANSWER THESE QUESTIONS?

1. What are the dimensions of the rough stock for the truck body?
2. How do you intend to shape the axle to fit the truck body?
3. If the trailer sides were made in one continuous piece, how long would that piece be?
4. Where do you plan to secure the metal for the trailer sides?
5. Of what materials is cold glue made?

19. DELIVERY TRUCK

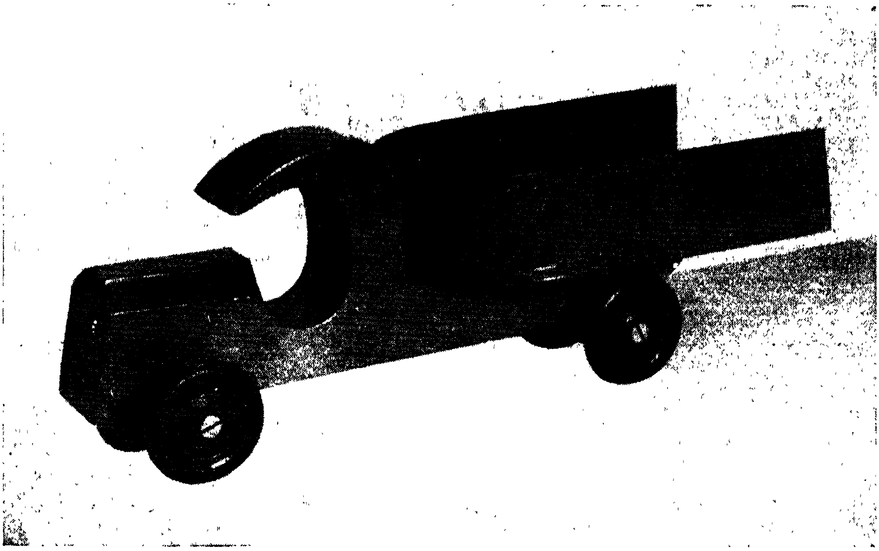


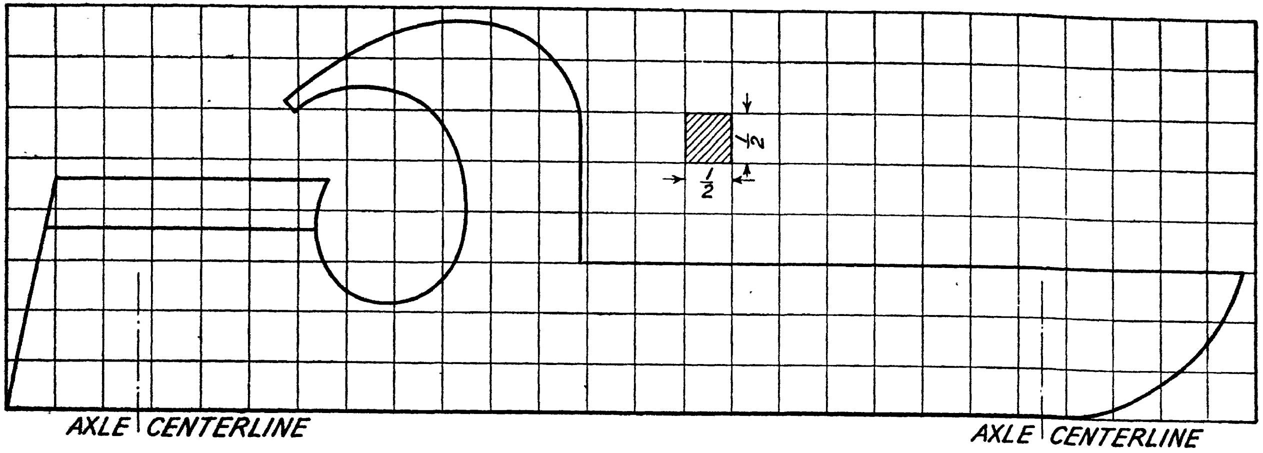
Fig. 99.

The delivery truck (Fig. 99) is an excellent playtoy because it holds a young child's interest. This truck can be used to haul bits of wood, sand, stones, or other things with which young children like to play. Most boys find that there is as much fun in making this toy as there is in playing with it.

CONSTRUCTION SUGGESTIONS

In planning, it will be helpful to divide the project into the following jobs:

Job 1. Make the Truck Cab (Fig. 100).
Job 2. Make the Axle Blocks (Fig. 101).
Job 3. Make the Bottom of the Body (Fig. 102).
Job 4. Make the Sides of the Body (Fig. 103).
Job 5. Assemble the Truck.
Job 6. Apply Enamel to the Truck.



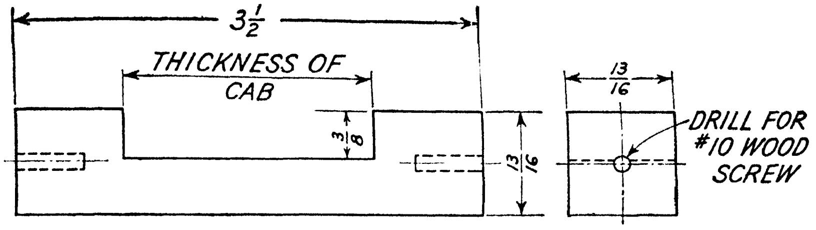
$\frac{1}{2} \times \frac{1}{2}$ CHAMFER
ON BOTH SIDES
OF MOTOR HOOD

2" STOCK REQUIRED
FOR CAB

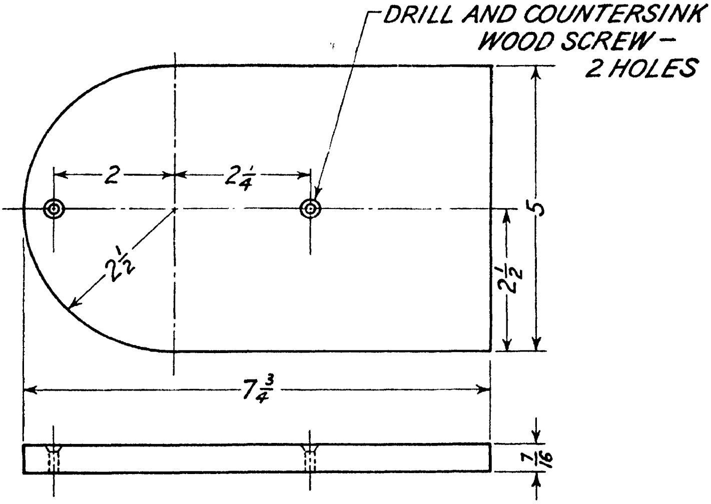
4–2" WHEELS REQUIRED

TRUCK CAB

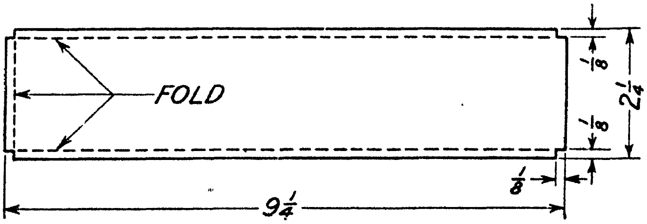
FIG. 100.



AXLE BLOCK
2 REQ'D
FIG. 101.



BOTTOM
FIG. 102.



BODY SIDE
LIGHT GAGE METAL
2 REQ'D
FIG. 103.

The truck cab should be sawed from a piece of clear white pine. It is possible to saw the cab out by hand but if a jig saw or band saw is available, either can be used.

Care should be taken in making the axle blocks so that when they are assembled to the cab, all the wheels will ride on the ground. If glue is used with the nails when fastening the axle blocks to the cab, the joint will be stronger.

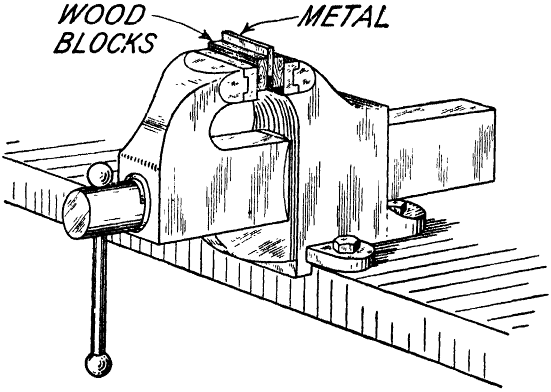


FIG. 104.

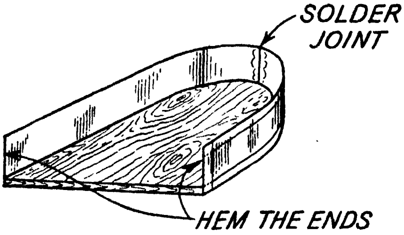


FIG. 105.

Material for the sides of the body can be obtained from discarded metal cans. A bar folder can be used to fold the hems on the body sides. If this machine is not available, the metal can be clamped between two pieces of wood or iron (Fig. 104).

If material of the correct length can be obtained, the sides of the body can be made of one piece. If the sides of the body are made in two pieces, one end of each piece is hemmed (Fig. 105). The pieces are soldered together after they are nailed to the truck body.

Wheels for the truck can be obtained from discarded toys or they can be purchased from a store handling model supplies. The wheels should be painted before they are fastened to the truck.

VARIATIONS IN DESIGN

A cloth canopy could be added to a square body; the truck would then become an army transport (Fig. 106). Coat-hanger wire can be used to make the framework for the canopy.

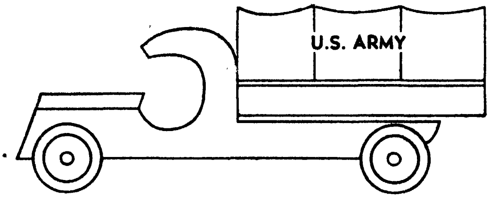


FIG. 106.

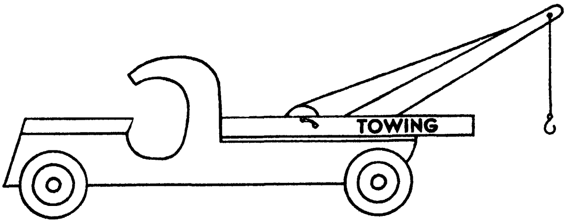


FIG. 107.

A rectangular body with low sides and a hoist will transform the delivery truck into a towing truck (Fig. 107). Other details of the towing truck are left to the ingenuity of the student.

TRY THESE QUESTIONS

1. What are the dimensions of the rough stock for the truck cab?
2. How could you determine the total length of the sides of the body if they were made from one piece of metal?
3. If the body sides were made in one piece how long would that piece be?.
4. What is the difference between flat paint and enamel?
5. How could the design be varied if metal were not available for the sides of the body?

20. EXPERIMENTAL ELECTRICAL MOTOR

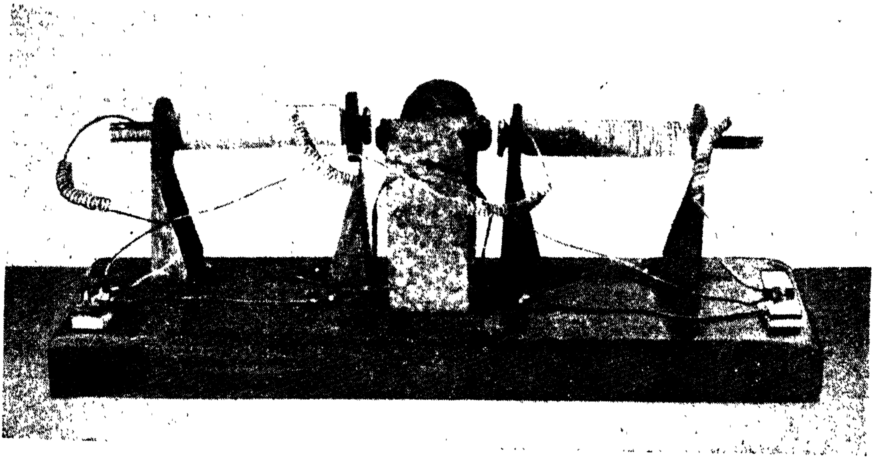


FIG. 108.

This electric motor (Fig. 108) has been designed so that it can be built of easily secured standard materials. The electromagnets can be removed and used separately for experiments with magnetism. The motor can be operated with a toy transformer or several dry cells.

SUGGESTIONS FOR PLANNING

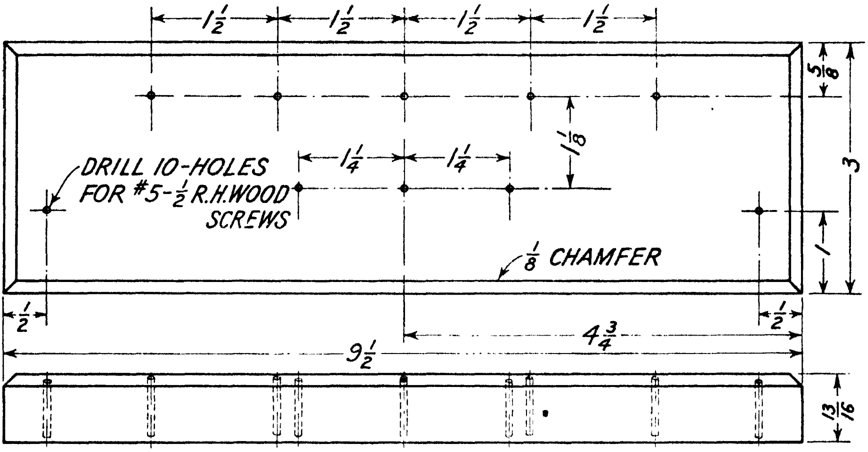
To make the planning easier, divide the project into the following jobs, and then plan each job separately:

Job 1. Shape the Base (Fig. 109) and Apply the Finish.
Job 2. Form the Metal Parts (Fig. 110).
Job 3. Assemble the Cores and Wind the Coils (Fig. 111).
Job 4. Make the Armature (Fig. 112).
Job 5. Assemble and Wire the Motor (Fig. 113).

The anchor holes for the screws in the motor base should be laid out *exactly* as shown in Fig. 109.

The holes in the brackets and other metal parts may be punched with a ⅛-inch solid punch, but they can be drilled if a punch of that size is not available. The bends in the metal can be made in a metal vise (Fig. 114).

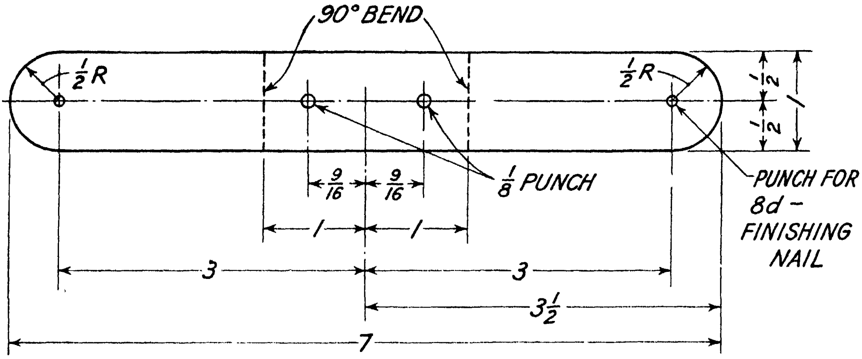
The core of the magnet is made of a 60 penny spike fitted with two fiber washers. Rubber faucet washers may be used if fiber washers are not available. Approximately 110 feet of No. 26 gage cotton-covered wire are needed for each coil. A hand drill can be used for winding the wire onto the core. The iron core is held in the chuck of the hand drill, and the hand drill is held in a vise. The coil can be wound evenly and quickly in this manner. The ends of the wire are inserted in the holes in the washers; about 12 inches of wire are left on each end of the coil for making the connections (Fig. 115).



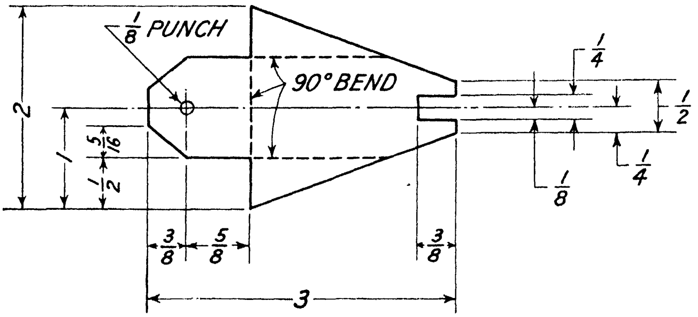
MOTOR BASE

FIG. 109.

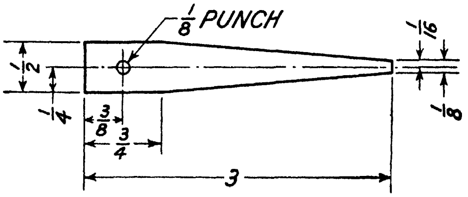
The armature shaft is made by drilling a hole in a piece of a 60 penny spike to fit an 8 penny nail (Fig. 116*A*). The head is cut from the finishing nail, and then the nail is inserted in the hole and soldered in place (Fig. 116*B*).



ARMATURE SUPPORT — 1 REQ'D.
26-GAGE IRON



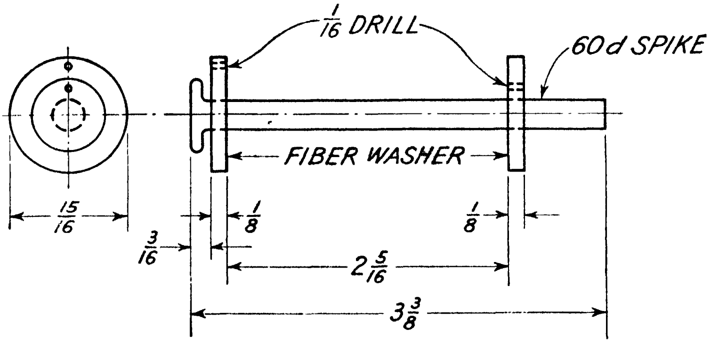
COIL SUPPORT — 4 REQ'D.
26-GAGE IRON



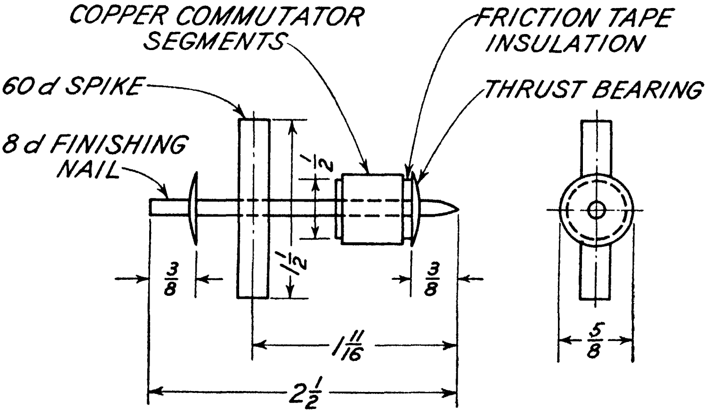
ARMATURE BRUSH — 2 REQ'D.
26-GAGE COPPER

FIG. 110.

Two 5/8-inch thrust bearings are made of galvanized iron and drilled to fit the 8 penny finishing nail. When the thrust bearings are soldered in place, some difficulty may be encountered (Fig. 117). The nails and thrust bearings must be polished bright immediately before soldering, so that the solder will stick.



FIELD COIL
2 REQ'D
FIG. 111.



ARMATURE
FIG. 112.

The armature coil can be wound only by hand. Both sides of the coil should be wound in the same direction, that is, the

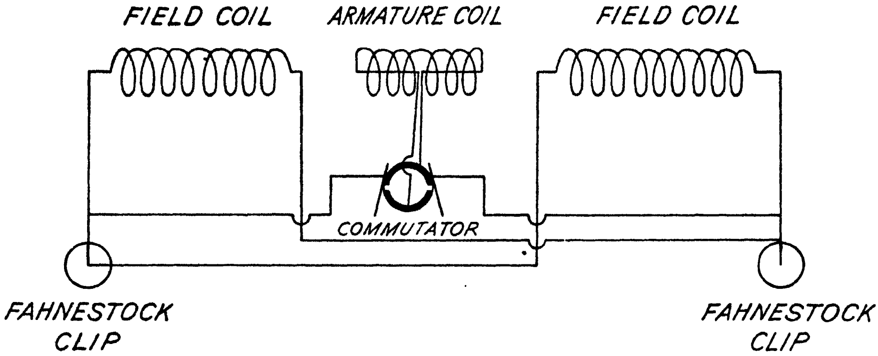


FIG. 113.

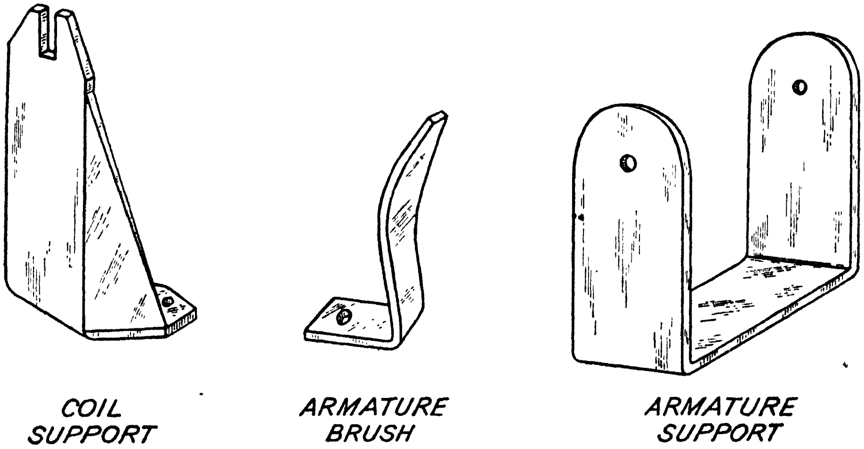


FIG. 114.

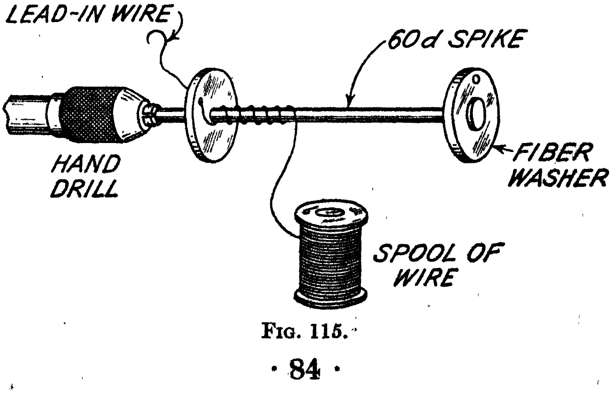


FIG. 115.

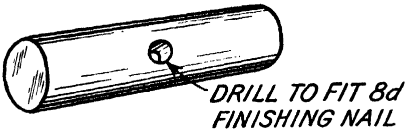


FIG. 116A.

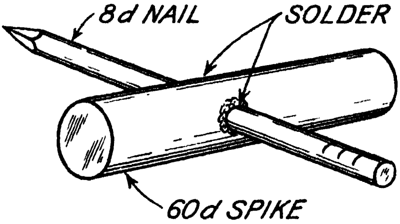


FIG. 116B.

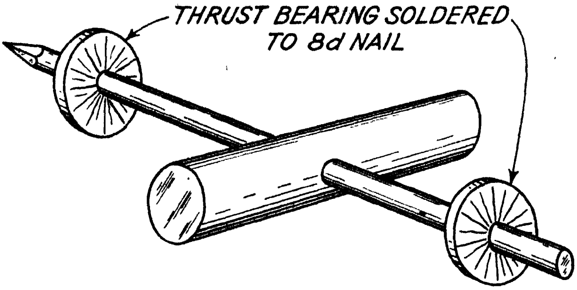


FIG. 117.

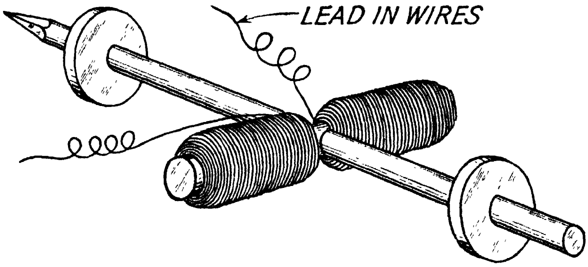


FIG. 118.

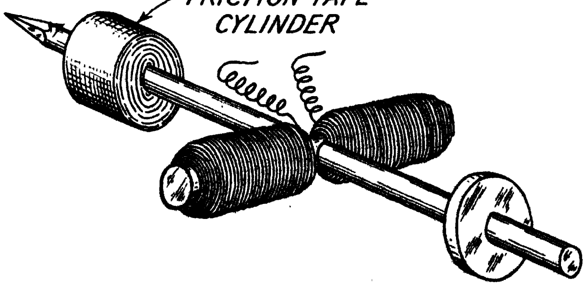
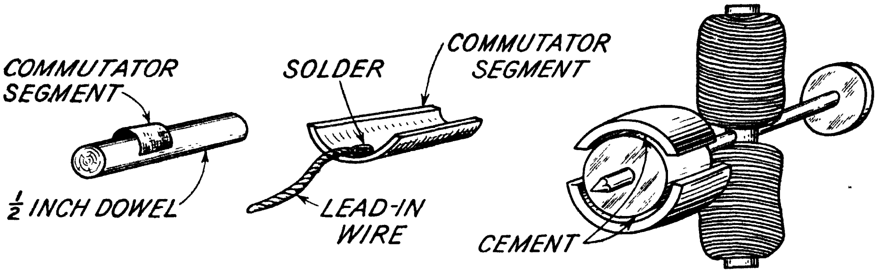


FIG. 119.

armature coil is wound as a single coil (Fig. 118). Approximately 80 feet of No.26 gage cotton-covered wire will be needed. The leads for the commutator segments should come out of the coil at the center, so that they can be soldered to the commutator segments.

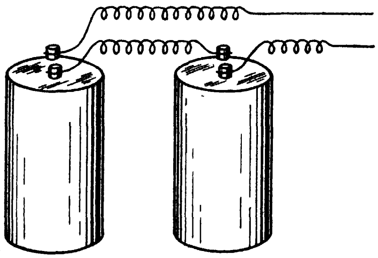


SHAPING THE SEGMENT

SOLDERING THE LEAD-IN WIRE

CEMENTING SEGMENTS IN PLACE

Fig. 120.



TWO DRY CELLS WIRED IN SERIES

Fig. 121.

Friction tape is tightly wound around the armature shaft to form a ½-inch cylinder (Fig. 119). This is the base for the commutator segments.

Two copper segments are shaped over a ½-inch dowel rod. One of the lead-in wires from the armature coil is soldered to the inside of one of the segments; the other lead-in wire is soldered to the inside of the other segment. Both segments are then cemented to the taped cylinder as shown in Fig. 120.

The brackets, brushes, and armature support are fastened to the motor base with ½-inch No. 5 roundheaded wood screws. Two fahnestock clips are mounted on the motor base. The connections for the field coils, armature, and brushes are shown in the wiring diagram (Fig. 113).

Before operating the motor, place a small amount of light machine oil on each armature bearing and on the commutator segments to reduce the friction. Connect a toy transformer or several dry cells wired in series to the motor (Fig. 121).

Spin the armature to start the motor. If the motor does not run, reverse the connections on one of the field coils. Some experimenting may be necessary to secure the proper tension on the brushes.

STUDY QUESTIONS

1. What kind of metal should be used for the commutator segments and why?
2. Where can you secure No.26 cotton-covered wire?
3. Why are the coils connected in parallel?
4. Describe what happens when like and unlike magnetic poles are placed near each other.
5. Where can you secure fahnestock clips?

21. SAILBOATS

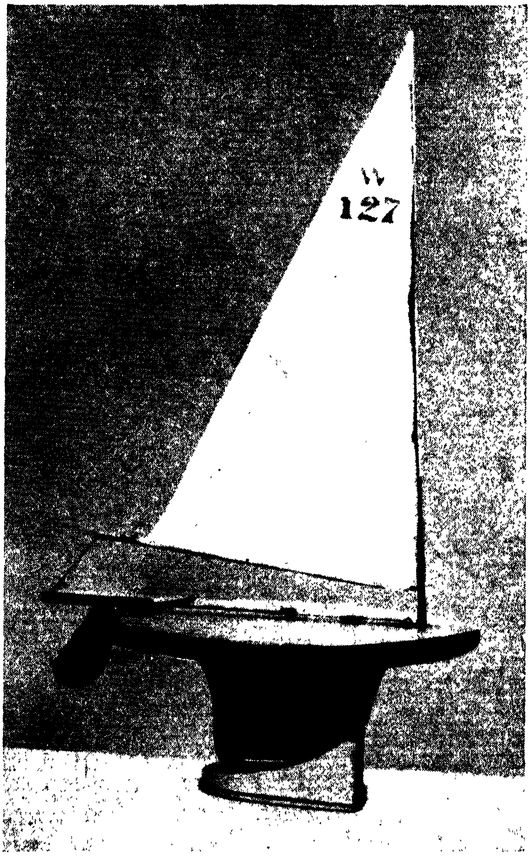


FIG. 122.

These sailboats (Figs. 122 and 123) have been designed especially for boys in the elementary and intermediate grades, but they are recommended for anyone who has never made a boat before.

To build these boats only a few hand tools are needed. The material for the 12-inch sailboat costs less than 50 cents, and the material for the 16-inch sailboat costs slightly more. The 12-inch sailboat requires about 18 hours to complete ready to sail, and the 16-inch sailboat needs only a small amount of additional time. The suggested methods of construction make previous experience in boatbuilding unnecessary. Boys who have learned to use a bench plane, handsaw, and spokeshave will find no difficulty in making either boat.

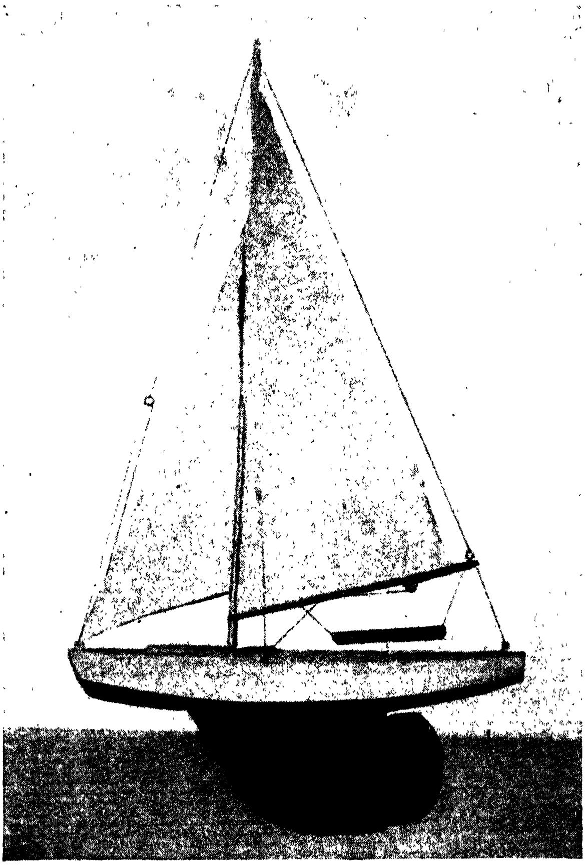
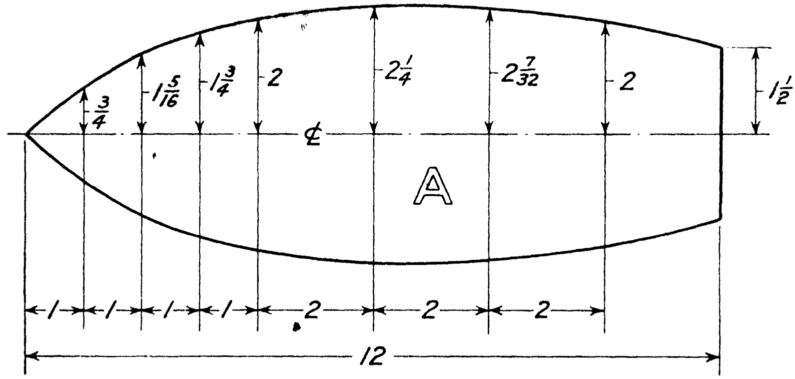


Fig. 123.

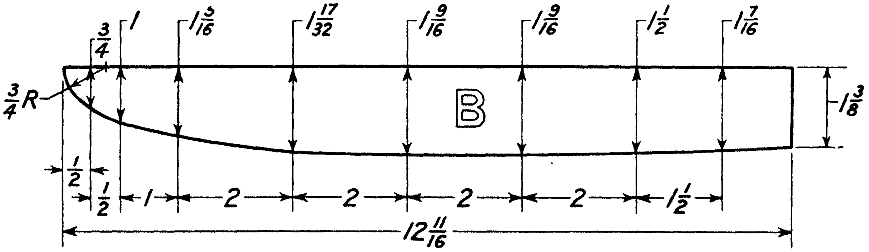
The main reason for making a sailboat is to have a boat for sailing and, because of the short time needed to build these boats, the builder may begin to enjoy sailing soon after the work on the boat is started. Both boats are good sailers; they are seaworthy and will not fill up with water and sink. The sail and the keel for both boats are carefully balanced to prevent the boats from tipping over in a strong breeze. The simple adjustments on the sail and automatic rudder enable the builder to sail his boat on a straight course. Boys who have built these boats have had little difficulty in making them and have had lots of fun in sailing and racing them.

22. PROCEDURE FOR BUILDING THE 12-INCH BOAT

The dimensions for the 12-inch boat were determined after a great deal of experimenting. As any change in the dimensions would destroy the sailing qualities, the builder is strongly urged to follow the directions carefully. For ease in planning, the project has been divided into the following jobs:



TEMPLET A-SYMMETRICAL ABOUT CENTER LINE



TEMPLET B

FIG. 124.

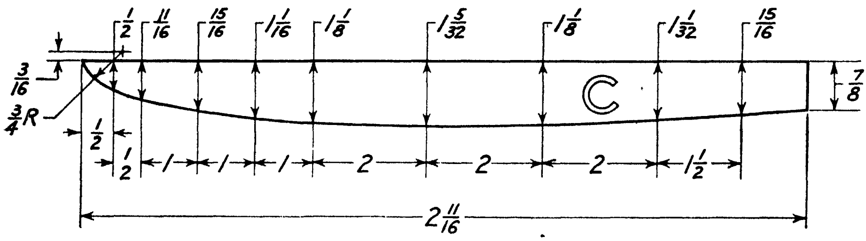
Job 1. Shape the Hull.

Job 2. Make the Keel.

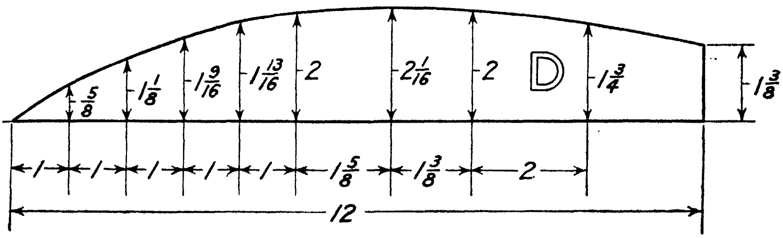
Job 3. Make and Pour the Mold.
Job 4. Make the Rudder.
Job 5. Apply the Finish to the Hull.
Job 6. Shape the Mast and the Boom.
Job 7. Make the Sail.
Job 8. Assemble and Rig the Boat.

Job 1. *Shape the Hull*

1. Make the templets. The templets can be made from the dimensions given in Figs. 124 and 125. If only one boat is to be made, cardboard templets will be satisfactory. If several boats are to be made, the templets should be made of sheet metal.



TEMPLET 'C'



TEMPLET D

FIG. 125.

2. Lay out and cut rough stock. A good grade of clear white pine is recommended because it is light and easy to work. The stock may be cut from a standard 2 × 6.

3. Trace the deck plan, templet *A* (Fig. 126).

4. Shape the hull to the deck plan. If a band saw is available, it may be used to saw out the hull, or the hull may be shaped to the deck plan by hand with a crosscut saw and a plane.

FIG. 126.

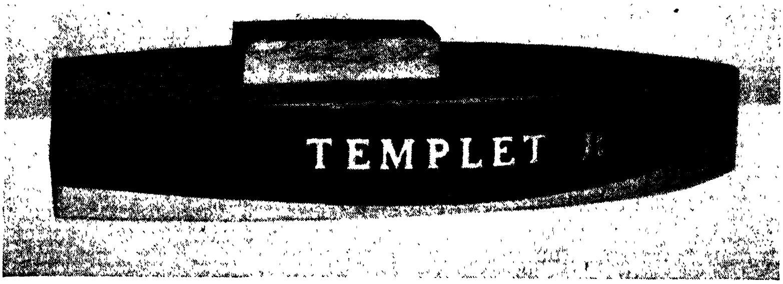


FIG. 127.

5. Attach a clamp block to the deck. A block of wood approximately ¾ × 2 × 5 inches should be attached with wood screws to the deck. The hull is held in the vise for shaping by clamping the block in the vise.

6. Trace the keelson line, templet *B* (Fig. 127). The templet should be traced on both sides of the hull.

7. Shape the hull to the keelson line. A plane and spokeshave should be used. The bottom should not be rounded.

8. Draw a center line on the bottom of the hull.

9. Lay out the working chine, templet *C*. The templet should be traced on both sides of the hull. The layout of the transom is illustrated in Fig. 128.

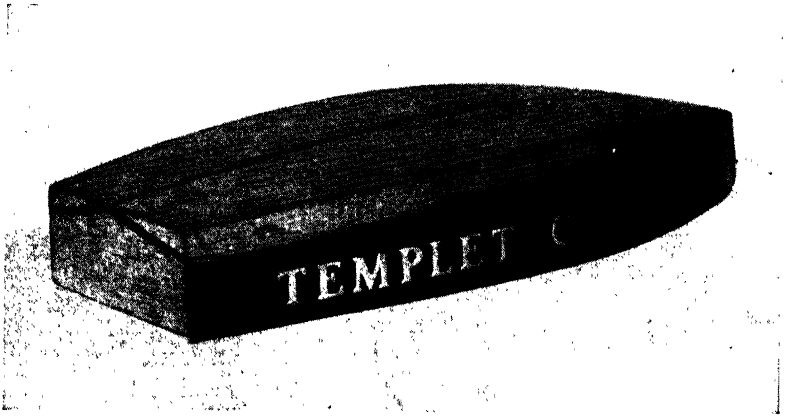


FIG. 128.

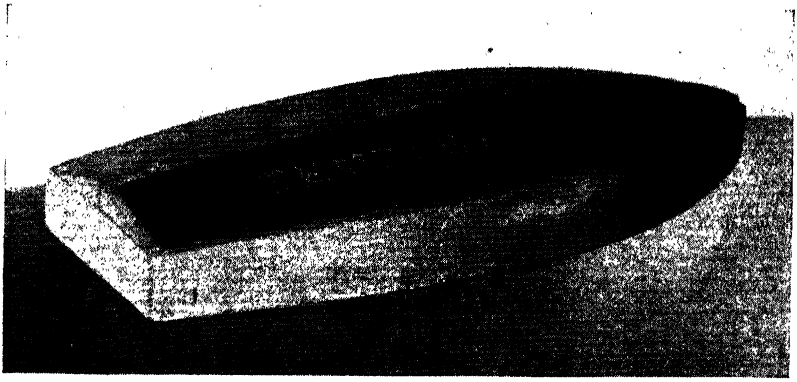


FIG. 129.

10. Shape the bottom of the hull. The wood between the center line and the working chine is removed with a plane and spokeshave.

11. Lay out the true chine, templet *D* (Fig. 129). The templet should be traced on both sides of the center line.

12. Shape the sides. The wood may be removed with a plane and spokeshave.

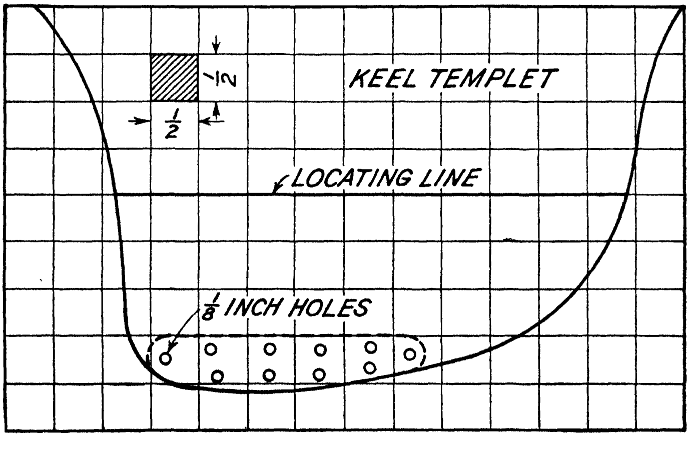
13. Lay out the sheer line (Fig. 130). The sheer line is 3/16 inch below the deck at the widest part of the deck.

14. Plane the deck to the sheer line.

Fig. 130.

15. Cut the saw kerf for the keel. The saw kerf is made 3/16 inch deep with a backsaw on the bottom of the boat along the center line.

16. Sand all surfaces.



KEEL
26 GAGE SHEET METAL—4½X7

Fig. 131.

Job 2. *Make the Keel*

1. Make the templet. The templet for the keel should be laid out by the proportionate square method (Fig. 131). If only one boat is to be made, a cardboard templet will be satisfactory. If several boats are to be made, the templet for the keel should be made of sheet metal.

2. Lay out and cut the rough stock. The keel for the 12-inch boat is made of No. 26 gage sheet metal. The shape of the keel has been simplified so that it can be cut out with tinner's snips.

3. Trace the outline of the keel. When the outline of the keel is traced, remember to mark the position of the locating line and, also, the position of the holes for the lead at the bottom of the keel.

4. Cut out the keel.

5. Punch or drill the holes.

6. Smooth the edges of the keel. A file and emery cloth can be used to advantage in smoothing the edges of the keel.

Job 3. Make and Pour the Mold

1. Rough out the stock for both pieces of the mold.

2. Square both pieces to the finished dimensions shown on the drawing (Fig. 132).

3. Locate and bore the holes for the bolts.

4. Trace the keel. The keel templet is centered on one of the mold blocks so that the locating line shown on the templet coincides with the edge of the mold block. The keel templet is then turned over and traced on the second block in the same relative position (Fig. 132).

5. Shape the recess in one mold block. Figure 133 shows the recess in one block deep enough so that the keel will fit flush with the surface. The recess can be cut with a chisel and gouge. The surface of the recess should not be irregular.

6. Lay out and trace the mold. The lead mold is shown full size in Fig. 134. Trace the outline of the mold on thin paper and then transfer the outline to the correct place on the mold block. Turn over the tracing paper and transfer the outline of the mold in the correct place on the other mold block.

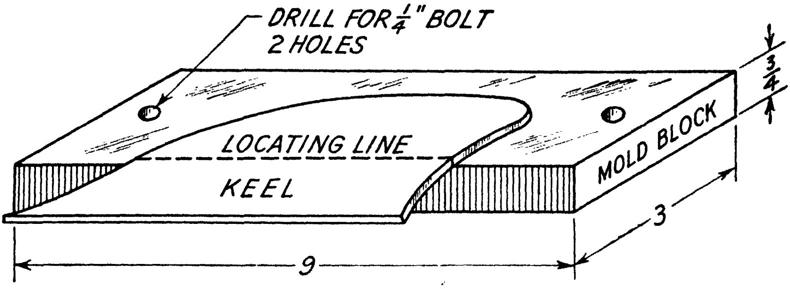
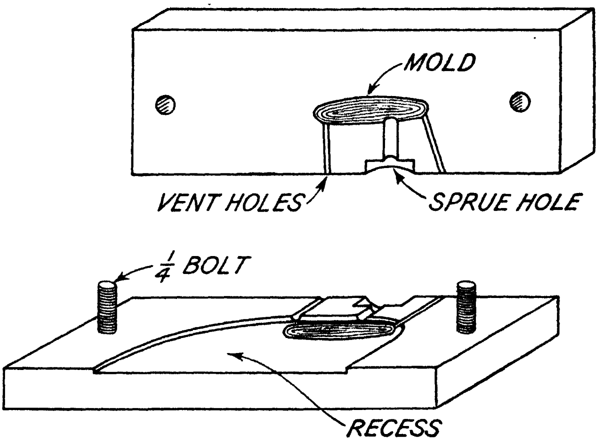
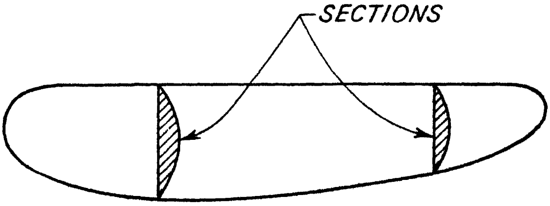


FIG. 132.



KEEL MOLD
READY FOR USE

FIG. 133.



FULL SIZE LAYOUT OF
KEEL MOLD

FIG. 134.

7. Gouge out the mold. The depth of the mold is shown in the cross-sectional view in the drawing. The mold in both mold blocks should coincide.

8. Locate and drill the air-vent holes. Bolt the mold blocks together and drill the air-vent holes as shown in the drawing. These holes allow the air to escape from the mold when the hot lead is poured.

9. Locate the bore and the counterbore and bore the holes. The mold blocks are bolted together, and the two holes are bored to form the sprue hole into the mold.

10. Clean the keel. The bottom of the metal keel should be polished bright with emery cloth, so that the lead will adhere to the keel. A coating of soldering flux, applied to both sides of the sheet metal, is recommended.

11. Pour the mold. Bolt the keel tightly in the mold blocks. Heat the lead to the melting point and pour it into the mold. If the lead is overheated, it will burn the wood. *Handle the molten lead carefully.*

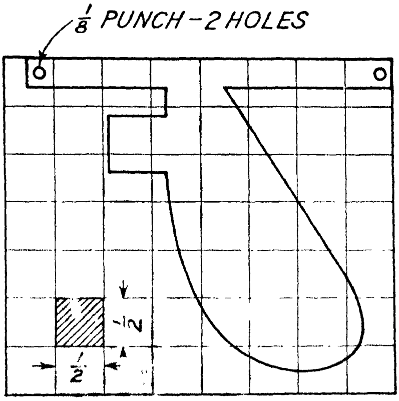
12. Remove the excess metal. Remove the keel from the mold and cut away the excess metal. The molded lead can be smoothed with a file and emery cloth.

13. Attach the keel to the hull. Sharpen the top edge of the keel with a file. Force the keel into place in the saw kerf which was cut in the bottom of the boat. Apply waterproof cement liberally and allow the cement to harden.

Job 4. *Make the Rudder*

1. Make the templet. The templet for the rudder should be laid out by the proportionate square method (Fig. 135). Cardboard is satisfactory if only one boat is to be made. If several boats are to be made, the templet for the rudder should be made of sheet metal.

2. Trace the outline of the rudder. The rudder for the boat is made of No. 26 gage sheet metal. The outline of the



RUDDER
26 GAUGE SHEET METAL $3\frac{1}{2} \times 4$

Fig. 135.

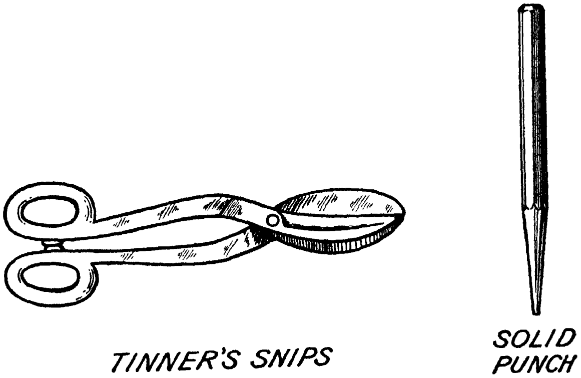


Fig. 136.

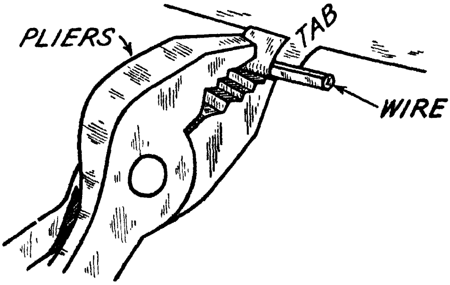


Fig. 137.

rudder and the locations of the holes should be marked on the metal with a scriber.

3. Cut out the rudder. The metal is cut with tinner's snips (Fig. 136). A file and emery cloth can be used to smooth the edges. The holes are punched with a ⅛-inch solid punch (Fig. 136).

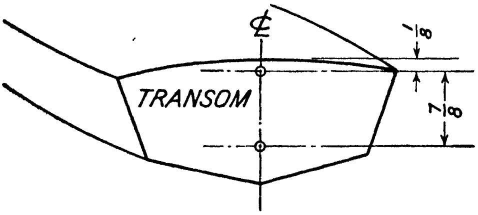


FIG. 138.

4. Form the hinge. A pair of pliers can be used to form the metal tab on the rudder (Fig. 137). The tab is formed around a piece of No. 12 wire 1 inch long.

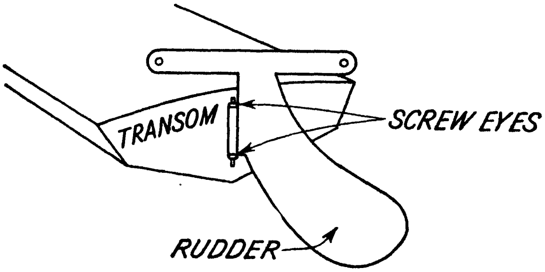


FIG. 139.

5. Locate and drill the holes for the hinge. The positions of the holes are shown in Fig. 138; they should be drilled for No. 216½ screw eyes. If screw eyes are not available, cotter pins of the correct size can be substituted.

6. Set the rudder in place (Fig. 139).

Job 5. Apply the Finish to the Hull

1. Prepare the surface. Crack filler can be used to fill any holes or checks in the wood. When the filler has hardened, sand the surface smooth. Remove any marks or scratches in the wood with sandpaper.

2. Apply a coat of enamel. The color of the enamel to be used is a matter of preference. The deck may be varnished a natural color or enameled white. Some boys prefer to enamel the deck the same color as the hull. Most boys like a bright color for the hull such as red, yellow, or blue. Usually, the best enamel job is the simplest one. It is not advisable to use too many colors.

It is necessary to consider how you are going to place the boat while it is drying. If you enamel the entire boat at one time, some means will have to be provided for hanging it up.

3. Sand the first coat lightly. When the first coat of enamel has thoroughly dried, sand the surface with a *worn* piece of fine sandpaper. Remove raised portions of the grain and all rough spots. The finish coat of enamel can be no smoother than the first coat. Wipe all dust from the boat with a damp cloth before applying the second coat.

4. Apply the second coat of enamel. Most boats require two coats but, occasionally, a third coat is necessary. If you plan to apply a third coat of enamel, sand the second coat lightly with *worn* sandpaper. Allow the finish coat of enamel to dry very thoroughly before handling the boat.

Job 6. *Make the Mast and the Boom*

1. Cut the stock to the lengths shown on the drawing. The mast and the boom are made of ¼-inch birch dowel. All wooden dowels are made perfectly straight, but some rods warp later owing to irregularities of grain and absorption of moisture. When selecting the dowel for the mast and the boom, try to get a straight one.

2. Taper the mast. The appearance of the mast is improved by tapering the top. A plane can be used to remove the wood. The length of the taper is shown in Fig. 140.

3. Sand the mast and the boom.

4. Locate and drill holes for the screw eyes. The locations of the holes for the screw eyes are shown on the drawing. The size of the holes to be drilled must be carefully determined to avoid splitting the wood. If screw eyes of the correct size cannot be obtained, small cotter pins can be used. Insert the screw eyes and assemble the mast and the boom.

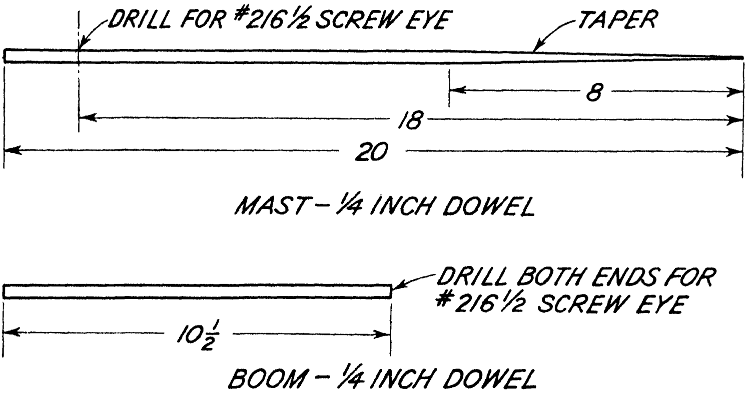

DRILL FOR #216½ SCREW EYE
TAPER
8
18
20
MAST – ¼ INCH DOWEL
DRILL BOTH ENDS FOR #216½ SCREW EYE
10½
BOOM – ¼ INCH DOWEL

FIG. 140.

5. Apply the finish. The mast and the boom may be varnished a natural color or enameled white. Two coats of either varnish or enamel should be used.

Job 7. Make the Sail

The material out of which the sail is to be made should be firm and closely woven. White Indianhead cloth makes a sail that will hold its shape well. Fine white cambric is more closely woven but makes a less durable sail. Either material is satisfactory for use in making the sail for your boat.

The size of the sail shown in Fig. 141 is the finished size. It is a good practice to make a full-sized pattern of paper for use in cutting the sailcloth. The pattern is placed on the cloth so that the free edge of the sail follows the selvage of the cloth.

Cut the cloth ¼ inch larger than the pattern to allow for a hem.

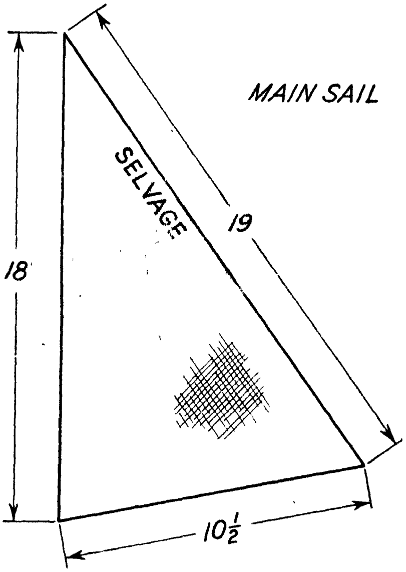


FIG. 141.

The hems can be sewn by hand or on a sewing machine. The corners should be carefully made (Fig. 142). Your mother or an older sister will be glad to help you with the job of making the sail.

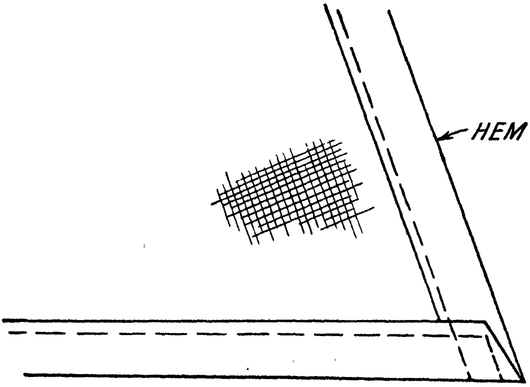
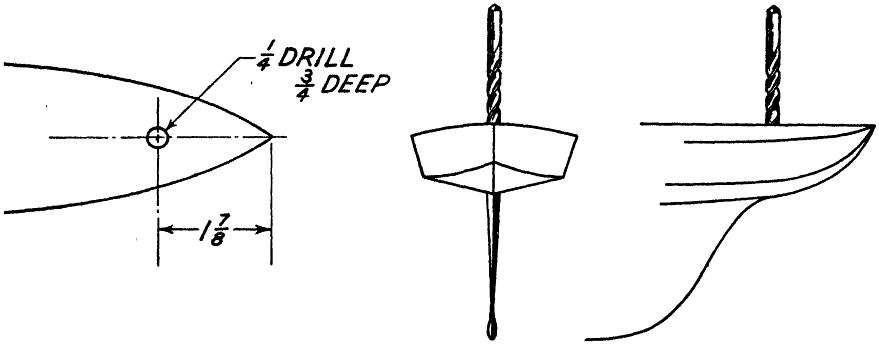


FIG. 142.

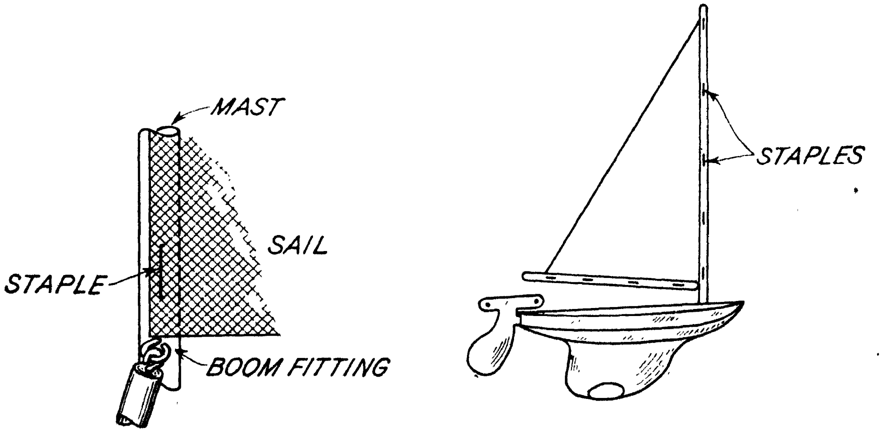
Job 8. Assemble and Rig the Boat

1. Set the mast. A ½-inch hole is drilled 1⅞ inches from the bow of the boat and ¾ inch deep. The hole should be carefully drilled, for the mast must be perpendicular to the deck (Fig. 143). You will be able to do a better job if another boy sights the bit for you. The mast will fit the hole and will stay in position without glue.



SIGHT THE BIT BOTH WAYS

FIG. 143.



STAPLES ARE DRIVEN IN THE BACK OF THE MAST

FIG. 144.

2. Attach the sail. Wire staples can be used to fasten the sail to the mast and the boom (Fig. 144). Staple the sail to the mast first, beginning at the bottom near the boom fitting. Space four or five staples along the mast.

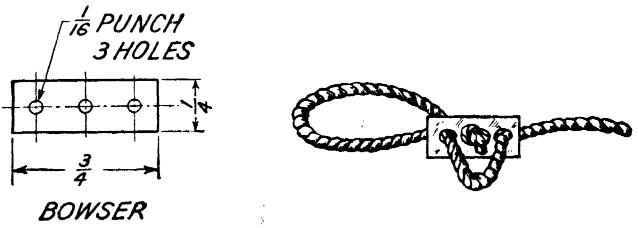


Fig. 145.

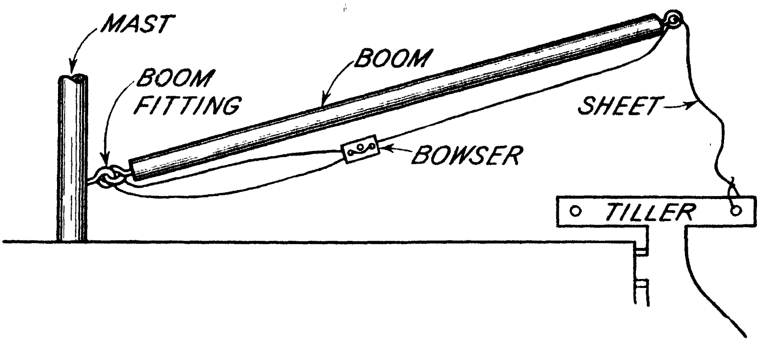


Fig. 146.

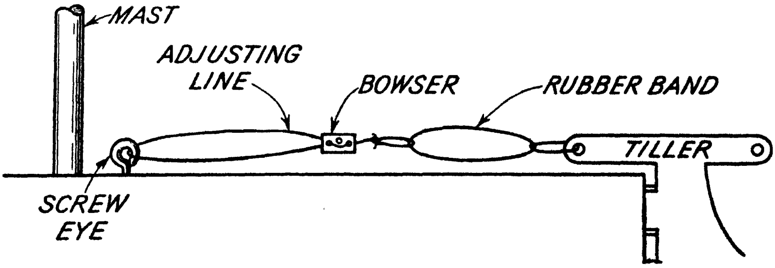


Fig. 147.

3. Make two bowsers. The bowsers are laid out and cut with tinner's snips. Holes are punched with a solid punch (Fig. 145). The bowsers should be made of copper or brass. They provide for both the adjustment of the boom and the tension on the rudder.

4. Attach the sheet. Any waterproof cord such as a fish line can be used for the sheet (Fig. 146). The sheet should be just long enough so that the boom can be pulled all the way in.

5. Rig the adjusting line on the rudder. A narrow rubber band is tied on the adjusting line. The adjusting line is assembled so that the bowser will increase or decrease the tension on the rudder (Fig. 147).

23. PROCEDURE FOR BUILDING THE 16-INCH BOAT

Any change in the dimensions of the hull or the sail plan will affect the sailing qualities of the boat. The builder is strongly urged to follow the specified dimensions carefully. To simplify the planning of the boat, the work has been divided into the following jobs:

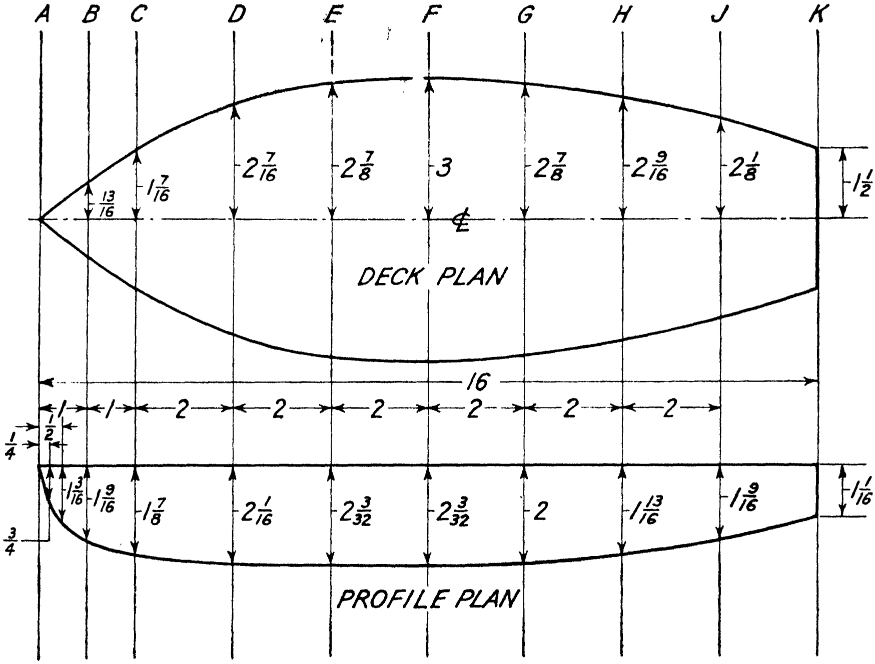


Fig. 148.

Job 1. Shape the Hull.
Job 2. Make the Keel.
Job 3. Make and Pour the Mold.

Job 4. Make the Rudder.
Job 5. Apply the Finish to the Hull.
Job 6. Shape the Mast and the Boom.
Job 7. Make the Sails.
Job 8. Assemble and Rig the Boat.

Procedures for each of the jobs have been prepared in detail to help you with your planning. They do not take the place of the plans that you will make as a part of your work. The numbering of paragraphs should not be confused with the steps in doing the job in your plan of work; they are given here to avoid confusion.

Job 1. *Shape the Hull*

1. Lay out the deck plan (Fig. 148). Select a piece of clear white pine, light in weight, 6 inches wide, 16 inches long, and 2¼ inches thick. Plane one of the surfaces, then lay out and draw a center line.

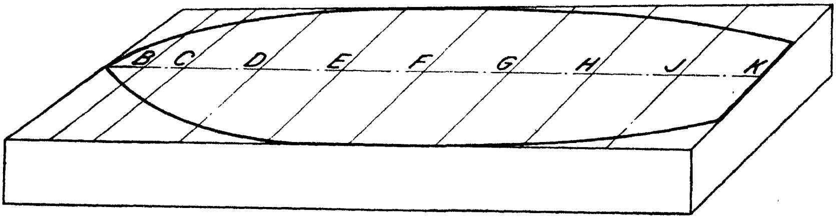


Fig. 149.

Lines *A*, *B*, *C*, etc., on Fig. 149 are called "station lines." The distances between these lines are shown. Lay out the station lines on the surface of the wood and letter them along the center line for later identification.

The distances from the center line to the deck line are shown as the lengths of the station lines. A pair of dividers are helpful to lay out the correct lengths of these lines on the surface of the wood. The dividers can be set for the correct dimension, and both sides of the deck plan determined at one time.

The points on the station lines thus secured determine the shape of the deck plan. A smooth curve can be drawn through these points by tracing along a thin strip of wood or cardboard to follow the station line points.

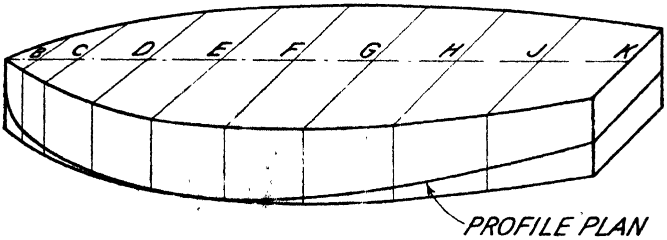


FIG. 150.

2. Shape the hull to the deck plan. The corners of the stock can be removed with a handsaw, and the wood shaped to the line with a plane or spokeshave. A band saw or jig saw can be used if either is available.

3. Lay out the profile plan. Extend the station lines from the deck plan down both edges of the hull. A try square will help you keep these lines at right angles with the deck.

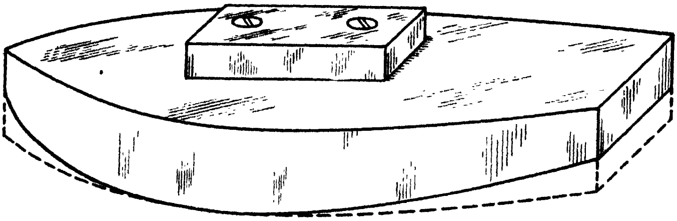
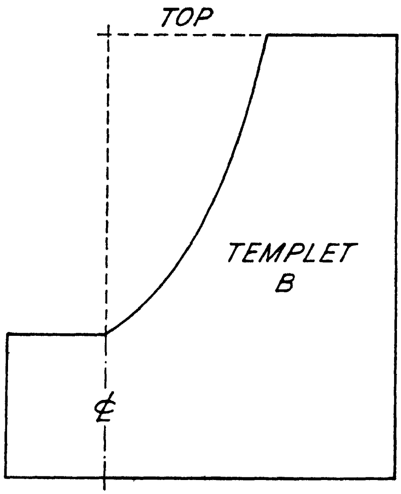


FIG. 151.

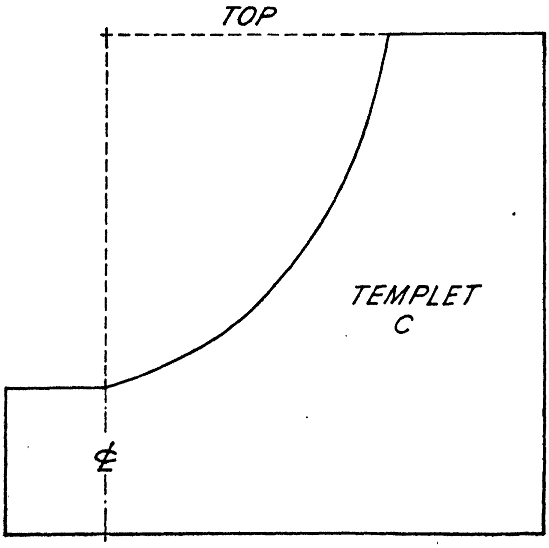
The lengths of the station lines on the edges of the hull determine the profile plan. The profile line is located and drawn on both edges in the same manner as the deck plan (Fig. 150).

4. Shape the hull to the profile plan. A small block of wood should be fastened to the deck with wood screws (Fig. 151). This block, when placed in the vise, holds the hull securely while the bottom of the boat is being shaped.

A plane can be used to shape the bottom of the hull to the profile plan.



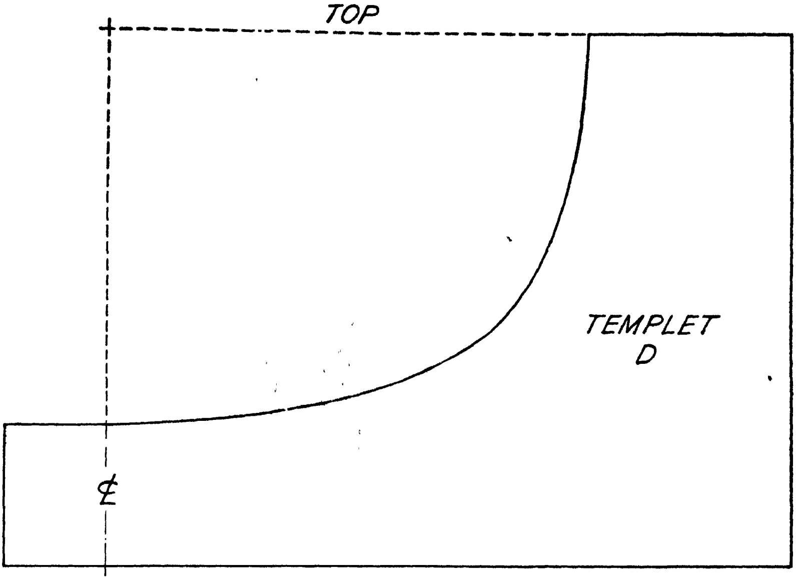
SECTION B



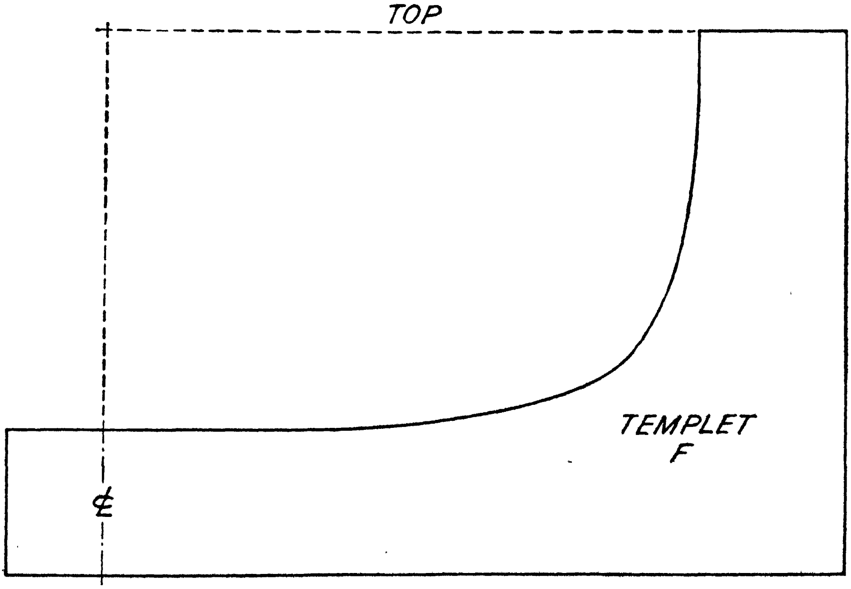
SECTION C

FIG. 152.—Templets. Shown full size.

5. Draw a center line on the bottom of the hull. The center line on the deck can be extended down the ends of the



SECTION D

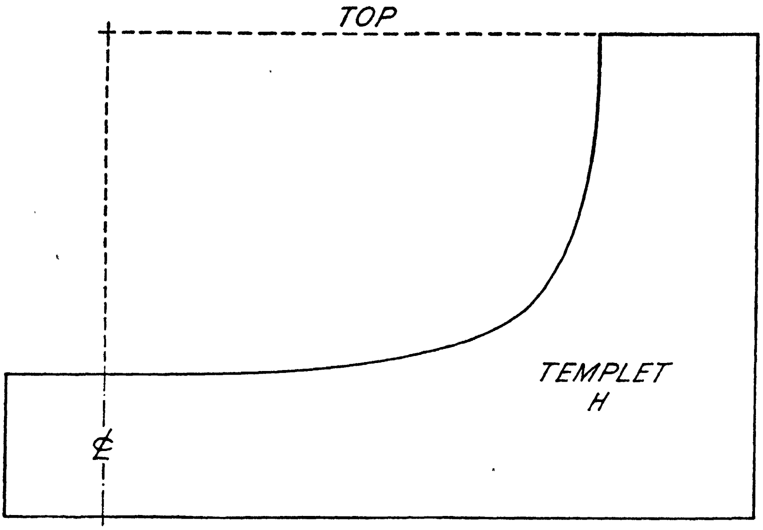


SECTION F

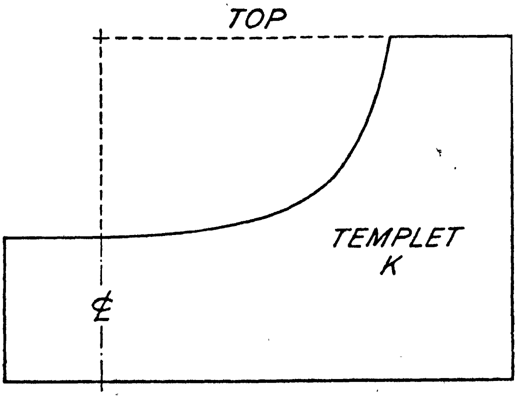
FIG. 152 (*Cont'd*).—Templets. Shown full size.

hull. When these two lines are connected, the center line will be accurately drawn.

6. Make the station templets. The six station templets, shown full size in Fig. 152, may be traced on a piece of paper and



SECTION H



SECTION K

Fig. 152 (*Cont'd*).—Templets. Shown full size.

then transferred to a piece of sheet metal, heavy cardboard, or thin plywood. It is quite important to work accurately when cutting the templets to shape.

Transfer the letters that appear on the drawings of the templets to the templets that you make. The letters *C*, *D*, *E*, etc., correspond to the station lines at which each templet is used. Also, transfer the positions of the center lines on your templets.

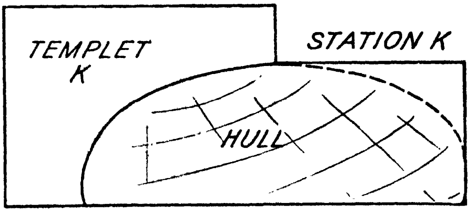


FIG. 153.

7. Shape the bottom of the hull to fit the templets. The stern of the boat is a convenient place to begin the shaping of the bottom of the hull. The wood is removed with a spokeshave until the hull fits the templet (Fig. 153).

8. Cut the saw kerf for the keel. The saw kerf is made ¼ inch deep with a backsaw on the bottom of the boat along the center line.

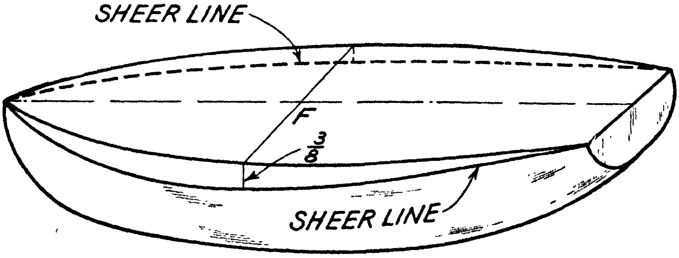


FIG. 154.

9. Sand the bottom of the hull. It will be an advantage to use coarse sandpaper to remove the marks of the spokeshave or plane. Fine sandpaper will then smooth the surface of the wood for painting later. After the hull has been thoroughly sanded, the wood block may be removed from the deck.

10. Lay out the sheer line. At station *F*, measure ⅜ inch from the deck on both edges of the hull (Fig. 154).

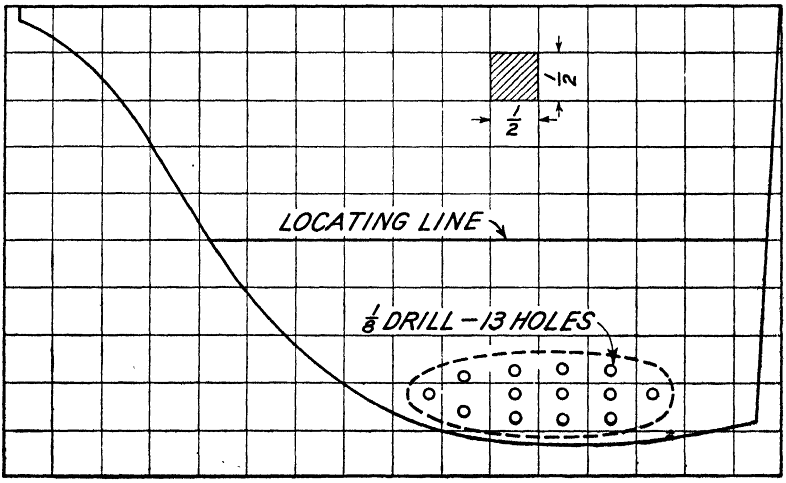
The sheer line will be curved and will pass through the points thus located. A smooth curve can be drawn by tracing along a thin wood strip.

11. Shape the deck to the sheer line. Use a plane to remove the wood on the deck. Some difficulty may be encountered because the boat cannot be held in a vise. Shape the deck so that the sheer line on both sides of the hull will be the same.

12. Sand the deck.

Job 2. Make the Keel

1. Make the templet for the keel. The templet can be laid out by the proportionate square method (Fig. 155).



KEEL – 1/8 PLYWOOD – 5X8

FIG. 155.

Cardboard is satisfactory for use if only one boat is to be made, but if a number of boats are planned then sheet metal should be used for the templet.

2. Trace the templet on the material used for the keel. Plywood 1/8 inch thick, exterior grade, is recommended for the keel. If this material is not available sheet metal can be used.

Mark the position of the holes at the bottom of the keel when tracing the templet.

3. Make the keel. A coping saw can be used if the keel is made of plywood; tinner's snips are used to cut sheet metal. The holes in the keel should be drilled. The edges of a metal keel can be smoothed with emery cloth and a file; the wooden keel can be smoothed with sandpaper.

Job 3. *Make and Pour the Mold*

1. Make two mold blocks. Square two pieces of stock to ¾ × 3 × 9. If the mold is to be used a number of times, it is advisable to make the blocks of a fine-grained hardwood such as birch or maple. Locate and bore the holes for the bolts (Fig. 156).

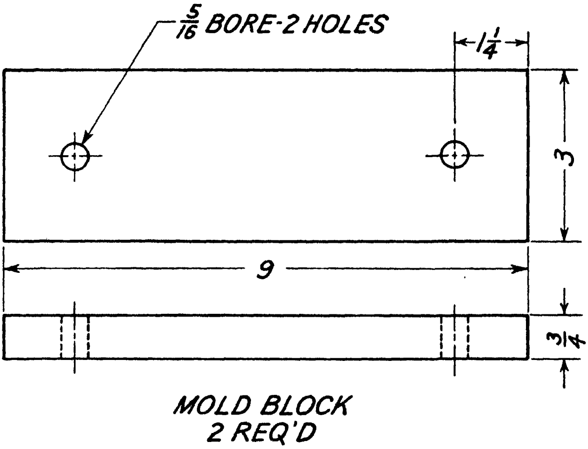


FIG. 156.

2. Shape a recess for the keel in one mold block. Center the keel templet on one of the mold blocks so that the locating line coincides with the edge of the mold block. Trace the templet in that position. Then turn the templet over and trace it on the second mold block in the same relative position.

Shape a recess in one block deep enough so that the keel will fit flush with the surface (Fig. 157). This recess can be cut with a chisel and gouge. The surface of the recess should not be irregular.

3. Lay out and gouge the mold for the lead in both mold blocks. The lead mold is shown full size in Fig. 158. Trace the outline of the mold on thin paper and then transfer to the correct place on the mold block. Turn over the tracing paper and transfer the outline of the mold on the other mold block.

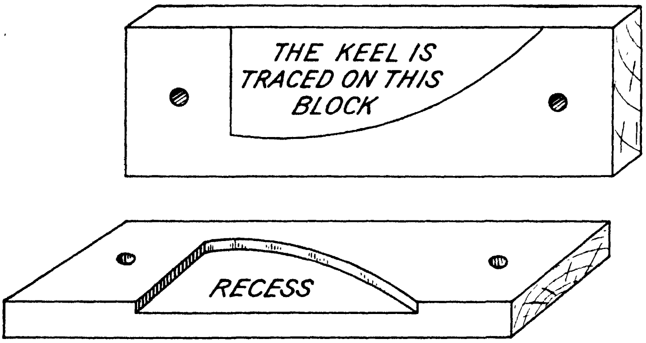


Fig. 157.

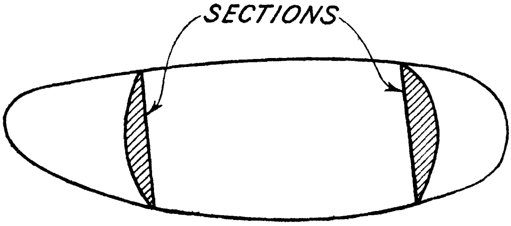


Fig. 158.

Gouge out the mold to the depth shown in the cross-sectional view. Be sure that the molds in both mold blocks coincide.

4. Drill the sprue hole and the air-vent holes. The air-vent holes allow the air to escape from the mold when the hot lead is poured. Bolt the mold blocks together, and drill two ⅛-inch holes into the mold between the two mold blocks (Fig. 159). This will leave half of the drilled hole in each mold block.

Hot lead is poured into the mold through the sprue hole (Fig. 160). Two holes are drilled to form the sprue hole. A

1-inch hole is bored ½ inch deep. Then a ¼-inch hole is bored into the mold.

5. Pour the mold. If the keel is made of metal, it should be polished bright with emery cloth, so that the lead will adhere to the metal. A coating of soldering flux applied to both sides of the metal is recommended.

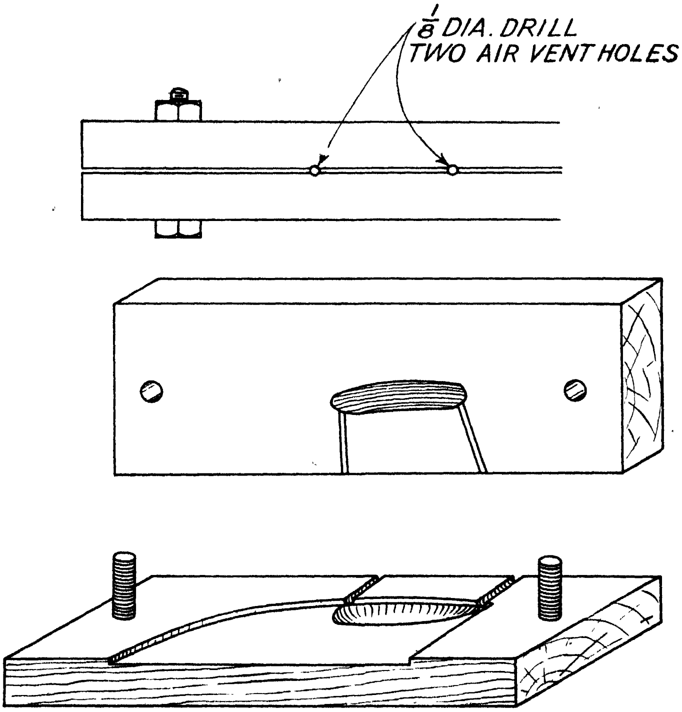


FIG. 159.

Bolt the keel tightly in the mold blocks. Heat the lead to the melting point, and pour it into the mold. If the lead is overheated, it will burn the wood. Handle the molten lead very carefully.

Remove the keel from the mold and cut away the surplus metal. The molded lead can be smoothed with a file and emery cloth.

6. Attach the keel to the hull. If the keel is made of plywood, the saw kerf in the bottom of the hull will need to be enlarged. The keel should fit the saw kerf firmly. Use waterproof glue to attach the keel and allow the glue to set before handling the boat.

If the keel is made of sheet metal, sharpen the top edge with a file and force it into the saw kerf. Apply waterproof cement liberally and allow the cement to harden before handling the boat.

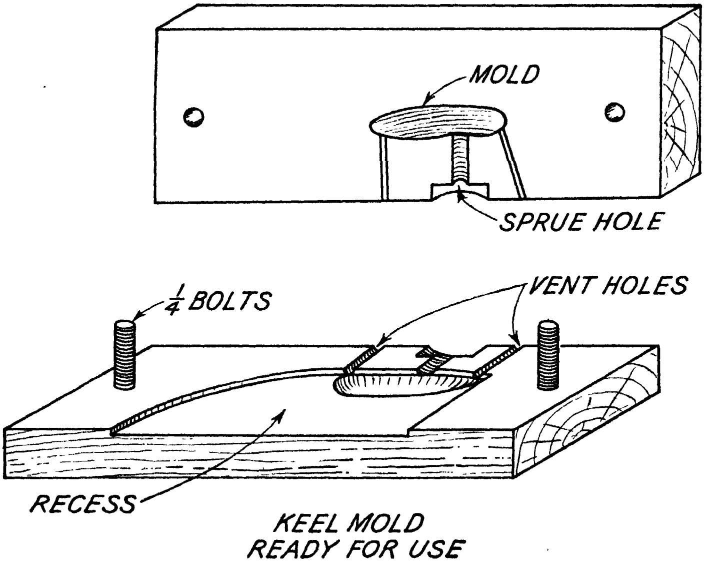


Fig. 160.

Job 4. Make the Rudder

1. Make the templet for the rudder. The templet for the rudder should be laid out by the proportionate square method (Fig. 161). Cardboard is satisfactory if only a few boats are to be made.

2. Trace and shape the rudder. The templet for the rudder is traced on a piece of $\frac{1}{8}$-inch plywood. The rudder

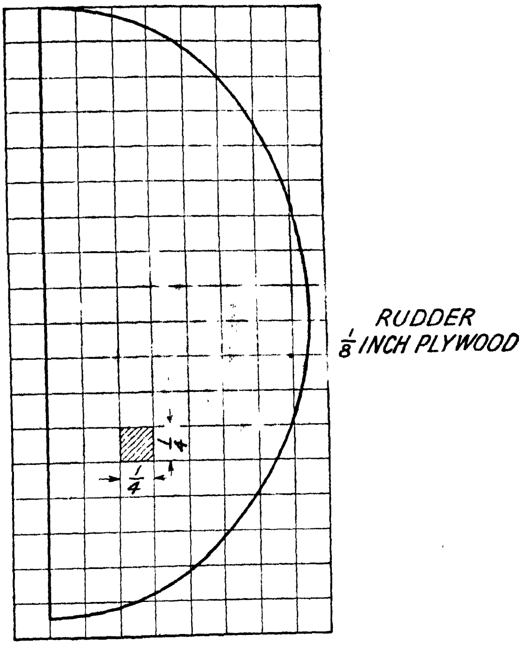


FIG. 161.

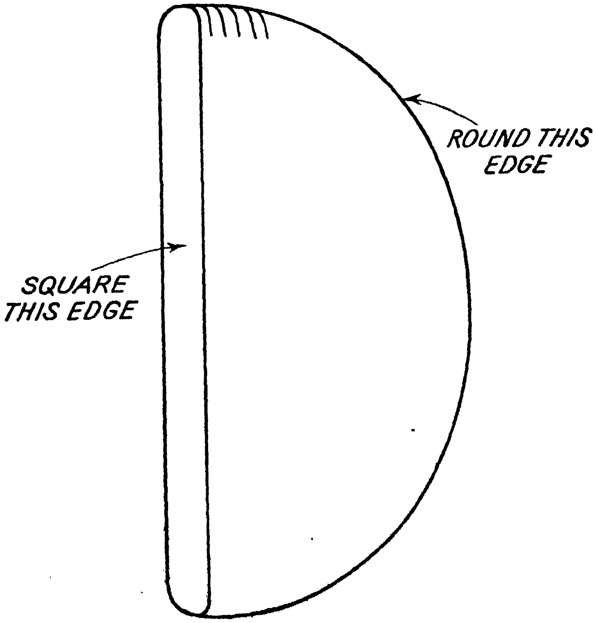


FIG. 162.

can be cut out with a coping saw, and the curved edges carefully rounded with sandpaper (Fig. 162).

3. Shape the rudder post. The rudder post is made from a piece of ¼-inch birch dowel (Fig. 163). A plane is used to shape the flat side. The slot for the tiller is carefully cut with a backsaw. The rudder post is sanded undersize so that it will fit loosely in the rudder tube.

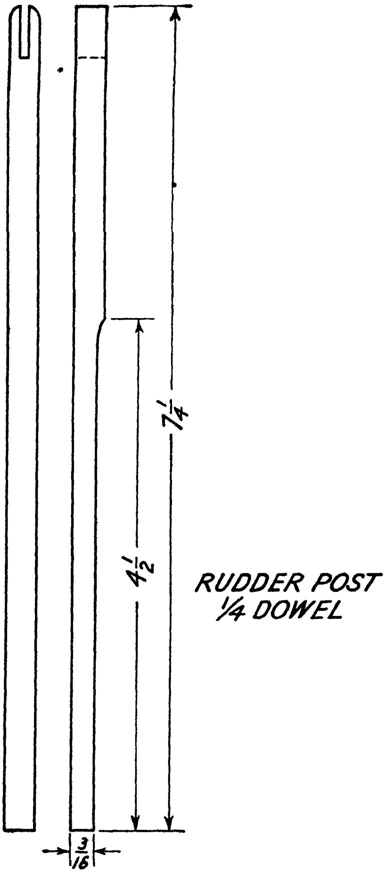


FIG. 163.

4. Cement the rudder to the rudder post. Waterproof cement should be used. The blade and the post may be clamped in a wood vise (Fig. 164).

5. Sand the rudder.

6. Locate and bore the hole for the rudder tube. Bore the hole from the bottom (Fig. 165). Keep the bit in line with the edge of the keel. The bit should come through the deck at the center line.

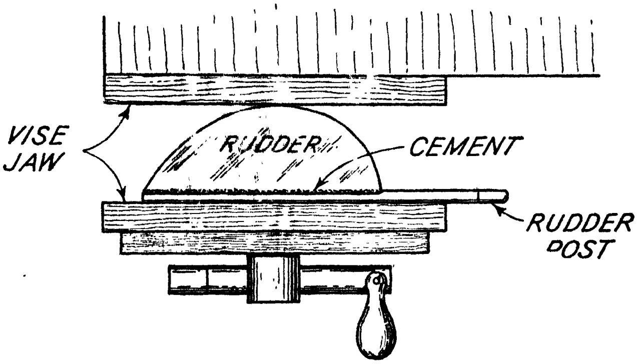


FIG. 164.

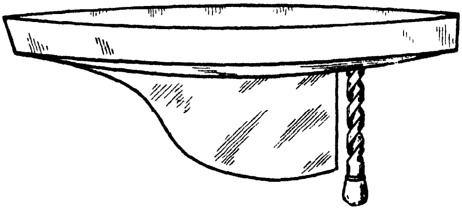


FIG. 165.

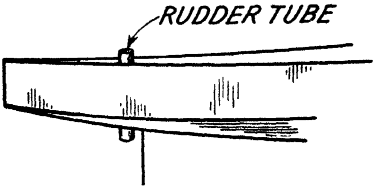


FIG. 166.

7. Cut the rudder tube to length. The rudder tube can be made of ¼-inch inside diameter thin-wall brass tubing (Fig. 166) which can be obtained from most model airplane stores. The tubing is scored with a knife and broken off.

8. Cement the rudder tube in position.

9. Lay out, drill holes, and shape the tiller (Fig. 167).

10. Assemble the rudder. Insert the rudder post in the rudder tube and cement the tiller in place (Fig. 168).

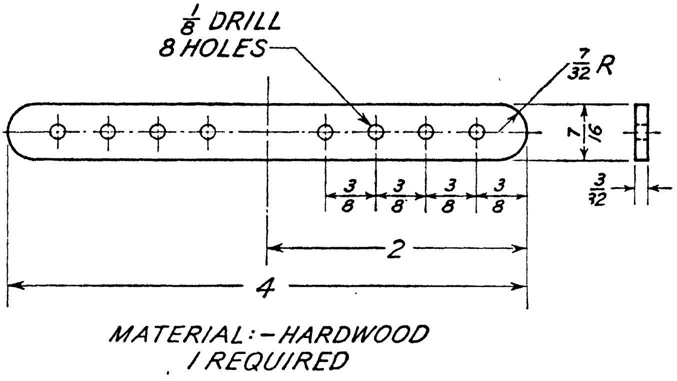


FIG. 167.

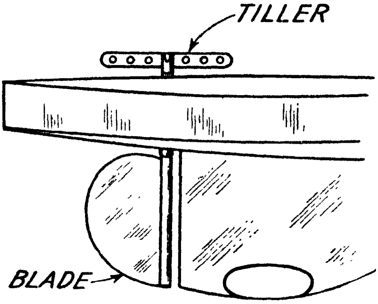


FIG. 168.

Job 5. Apply the Finish to the Hull

1. Prepare the surface. Fill any holes or checks in the wood with crack filler. When the filler is dry, sand the surface smooth. Remove any marks or scratches in the wood with fine sandpaper.

2. Apply a coat of enamel. You should consider how you are going to place the boat while it is drying. If you enamel the entire boat at one time, you will need some way to hang it up. Any plan that you want to use will be satisfactory; the important thing is that you have a plan.

The color of the enamel to be used is a matter of preference. The deck may be varnished a natural color or enameled white. If you wish to, you may enamel the deck the same color as the hull.

Most boys like a bright color for the hull, such as red, yellow, or blue. A water line may be painted on the hull. Usually, the best enamel job is the simplest one. It is not advisable to use too many colors.

3. Sand the first coat lightly. When the first coat of enamel has thoroughly dried, sand the surface with a *worn* piece of fine sandpaper. Remove raised portions of the grain and all rough spots. The finish coat of enamel can be no smoother than the first coat. Wipe all dust from the boat before applying the next coat of enamel.

4. Apply the second coat of enamel. Most boats require only two coats but, occasionally, a third coat is necessary. If you plan to apply a third coat of enamel, sand the second coat lightly with *worn* sandpaper. Allow the finish coat of enamel to dry very thoroughly before handling the boat.

Job 6. *Make the Mast and the Boom*

1. Cut the stock to the lengths shown in Fig. 169. The mast and the boom are made of ¼-inch birch dowel. All wooden dowel rods are made perfectly straight, but some rods warp later owing to irregularities of grain and absorption of moisture. When selecting the dowel for the mast and the boom, try to get a straight one.

2. Taper the mast. The appearance of the mast is improved by tapering the top. A plane can be used to remove the wood. The length of the taper is shown on the drawing.

3. Sand the mast and the boom.

4. Locate and drill holes for the screw eyes, and assemble. The location of the holes for the screw eyes is shown in Fig. 169. The size of the holes for the screw eyes must be carefully determined to avoid splitting the wood. Insert the screw eyes and assemble the mast and boom. If screw eyes of the correct size cannot be obtained, small cotter pins can be used.

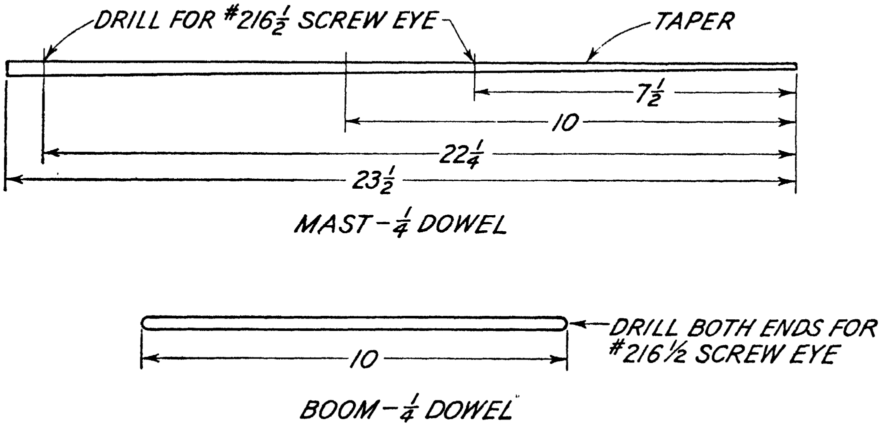

DRILL FOR #216½ SCREW EYE
TAPER
7½
10
22¼
23½
MAST – ¼ DOWEL
DRILL BOTH ENDS FOR #216½ SCREW EYE
10
BOOM – ¼ DOWEL

FIG. 169.

5. Apply the finish. The mast and the boom may be varnished a natural color or enameled white. Two coats of either varnish or enamel should be applied.

Job 7. Make the Sails

The material out of which the sails are to be made should be firm and closely woven. White Indianhead cloth makes a sail that will hold its shape well. Fine white cambric is more closely woven. Either material is satisfactory for use in making the sails for your boat.

The sizes of the sails shown in Fig. 170 are the finished sizes. It is a good practice to make a full-sized paper pattern for use in cutting the sailcloth. The pattern is placed in the cloth so that the free edge of the sail follows the selvage of the cloth. Cut the cloth ¼ inch larger than the pattern to allow for a hem. The hems can be sewed by hand or on a sewing machine. The corners should be carefully made (Fig. 171). Your mother or an older sister will be glad to help you with the job of making the sails.

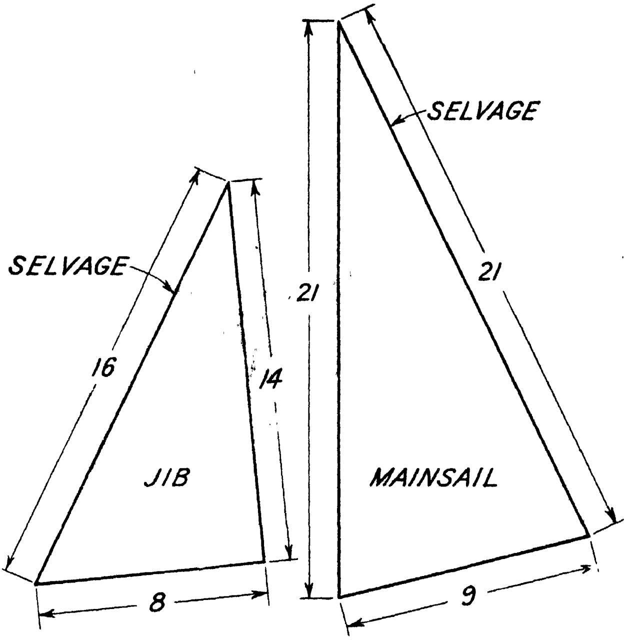


FIG. 170.

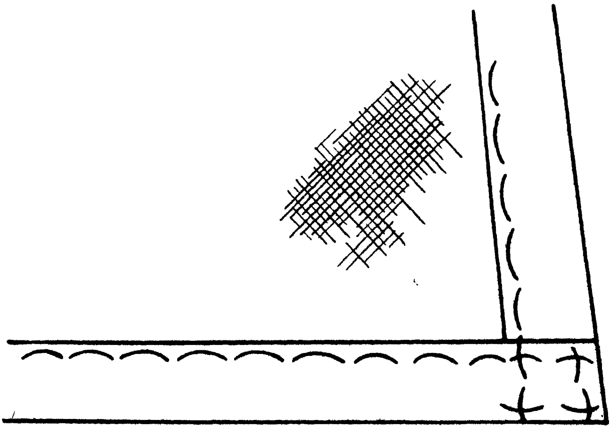


FIG. 171.

Job 8. *Assemble and Rig the Boat*

1. Set the mast. A mast step is made of ⅛-inch plastic, metal, or wood. A small wood screw and a No. 216½ screw eye should be used to fasten the mast step to the deck. The position of the mast step is shown in Fig. 172.

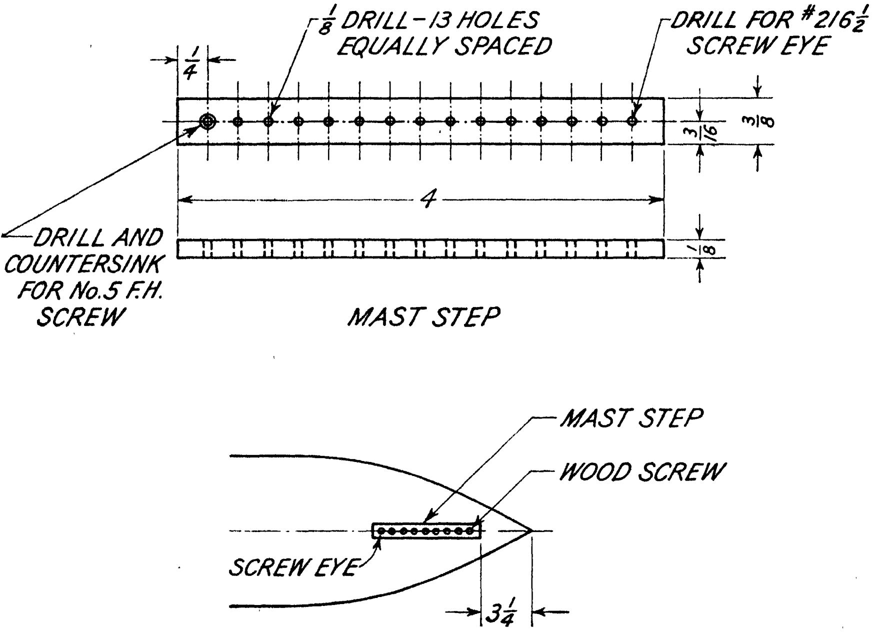

1/8 DRILL-13 HOLES EQUALLY SPACED
DRILL FOR #216 1/2 SCREW EYE
1/4
3/16
3/8
4
DRILL AND COUNTERSINK FOR No.5 F.H. SCREW
1/8
MAST STEP
MAST STEP
WOOD SCREW
SCREW EYE
3 1/4

FIG. 172.

A small hole is drilled in the bottom of the mast, and a 1½-inch brad inserted. The brad should be cut off so that it projects out of the mast ¼ inch (Fig. 173). Drill the hole for this brad so that it will fit tight. If the hole is too small, the mast may split.

2. Make seven bowsers. The bowsers can be made from a ⅜-inch plastic rod. A ¼-inch hole is drilled in the center to form a ring. Three 1/16-inch holes are to be drilled as shown in Fig. 174. If a plastic rod of the correct size is not obtainable make the metal bowser shown in Fig. 145.

A small drill may be made from a wire brad (Fig. 175).

3. Place the stays and the shrouds. The locations of the screw eyes for attaching the stays and the shrouds to the deck are shown in Fig. 176. A small hole should be drilled, and the screw eye turned in so that the eye just touches the deck.

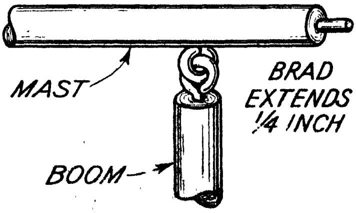


Fig. 173.

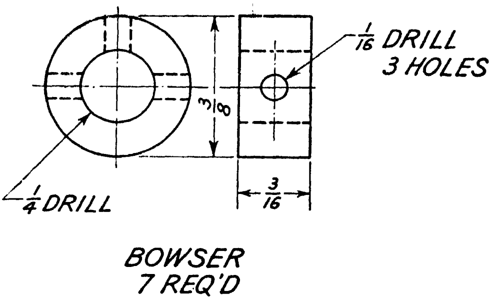


Fig. 174.

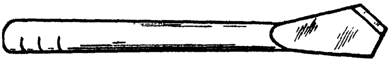


Fig. 175.

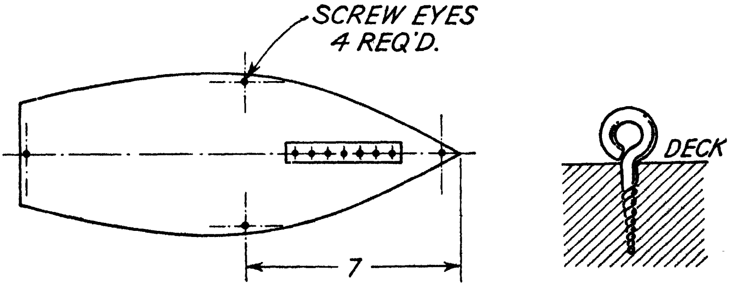


Fig. 176.

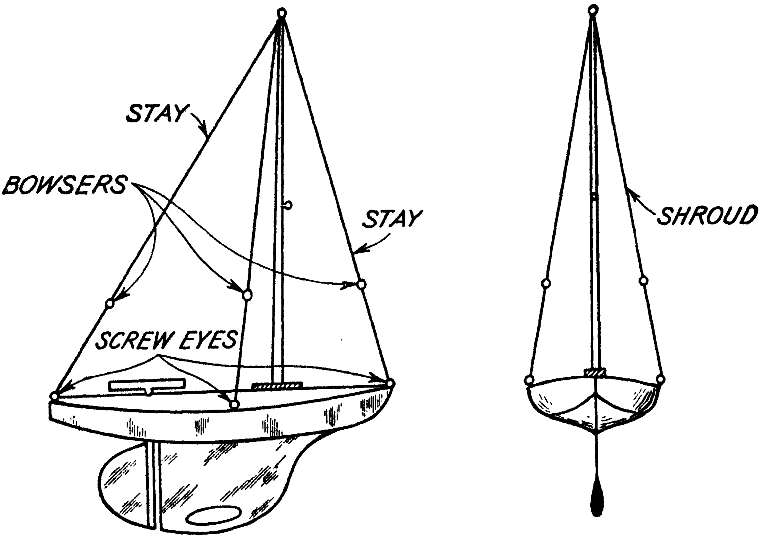


FIG. 177.

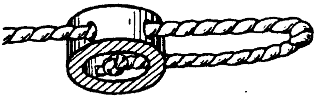


FIG. 178.

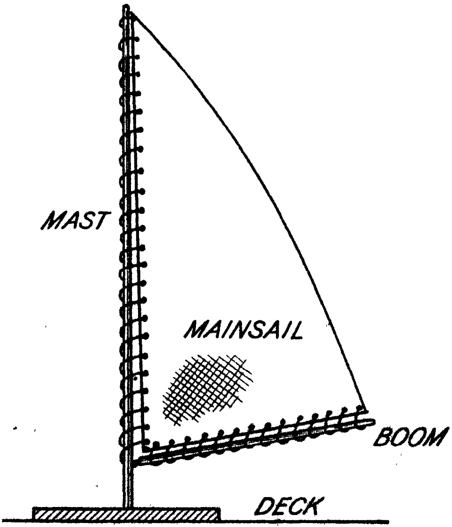


FIG. 179.

Waterproof cord, such as fish line, is used for the stays and the shrouds. In Fig. 177 the mast is held in place with stays and shrouds, and bowsers are rigged.

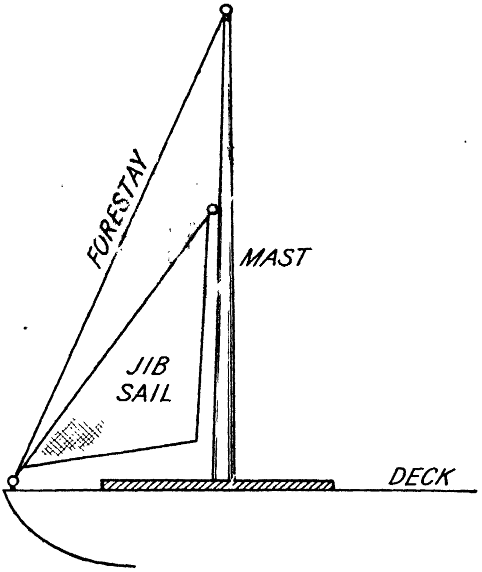


Fig. 180.

The bowser is used to adjust the length of the stay (Fig. 178).

When the stays and the shrouds are adjusted to the correct length, the mast is held perpendicular to the deck.

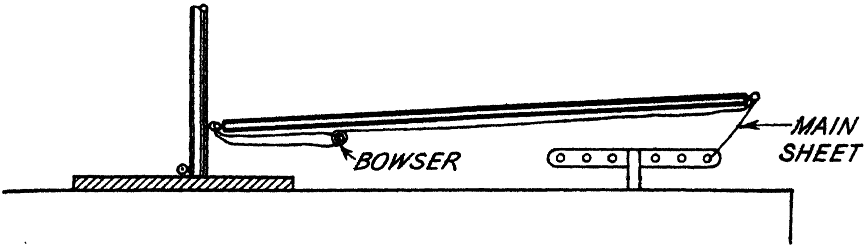


Fig. 181.

4. Attach the sails. The mainsail is attached to the mast and the boom with heavy thread (Fig. 179). The sail is prevented from slipping by tying the end of the thread to the screw eye at the top of the mast and at the end of the boom. The appearance of the finished job will be improved if care is

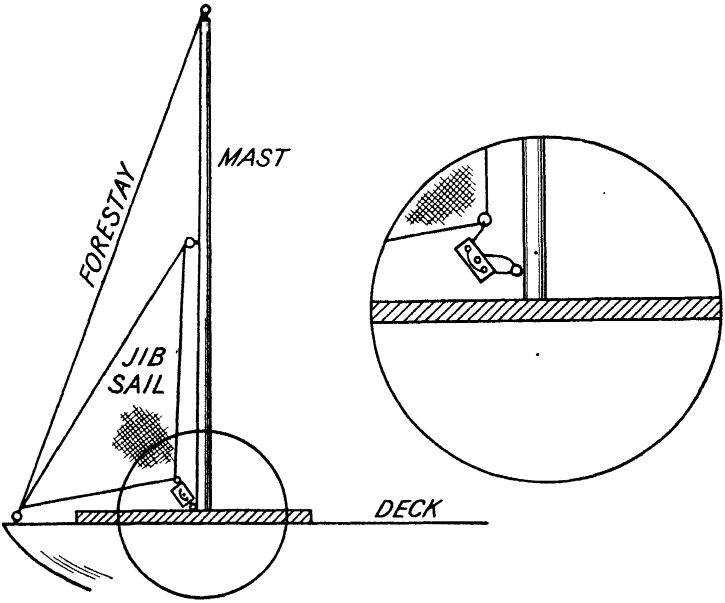


FIG. 182.

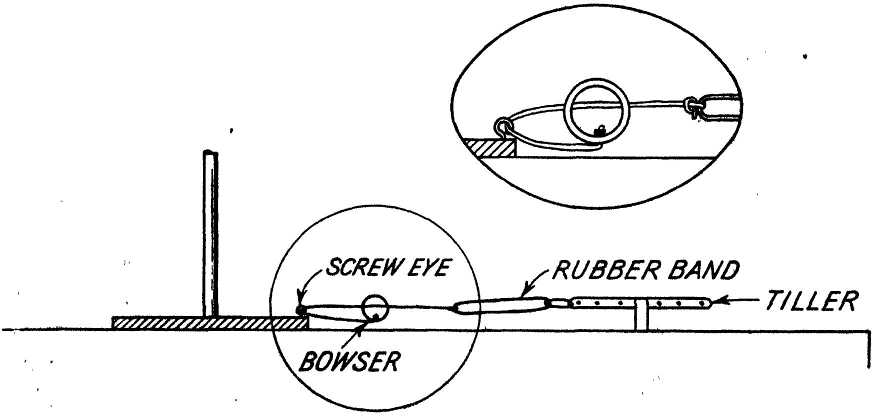


FIG. 183.

taken, when sewing on the sail, to get the stitches an equal distance apart. Be sure to tie all knots securely.

When the jib is made, a waterproof cord is placed in the hem of the longest side. One end of this cord is tied firmly to the screw eye in the mast, and the other to the screw eye in the deck (Fig. 180).

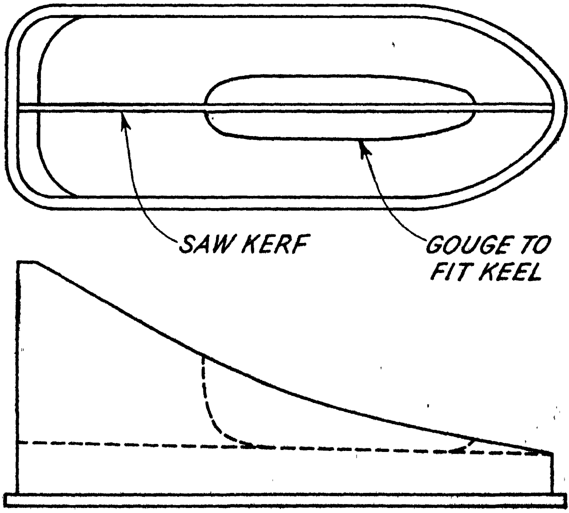
5. Rig the mainsheet. Any waterproof cord, such as a fish line, can be used for the mainsheet. It should be just long enough so that the boom can be pulled all the way in (Fig. 181).

6. Rig the jib sheet. The jib sheet should be long enough to allow the jib to swing out at right angles to the boat. The bowser permits easy adjustment (Fig. 182).

7. Rig the adjusting line on the rudder. A narrow rubber band is tied to the adjusting line (Fig. 183). The line is assembled so that the bowser will increase or decrease the tension on the tiller.

24. BOAT STAND

Fig. 184.



BOAT STAND

Fig. 185.

BOAT STAND

Every boatbuilder will want to make a stand to display his sailboat. The stand should be sturdily constructed and attractive. This boat stand (Fig. 184) is easily made and displays the boat in an attractive manner.

The material for it can be secured from the cuttings of the sailboat hull. This curved piece is just large enough to make a satisfactory stand (Fig. 185). The exact dimensions will depend on the size of the boat.

If a base is added to the stand it should be the same shape as the bottom. Attach the base with wire brads and set the heads below the surface of the wood.

25. SUGGESTIONS FOR CONDUCTING A MODEL SAILBOAT RACE

Boys enjoy sailing the boats that they have made (Fig. 186). They also enjoy experimenting with rudder and sail adjustments in order to sail a course under varying wind conditions. Even though it is lots of fun just to sail a boat, it is natural to want to race against other boats to find out which is the fastest. Very little preparation is necessary when a few boys are racing their boats but, when there are many boys, it is necessary to make certain arrangements.

FIG. 186.

SUGGESTIONS FOR CONDUCTING A SAILBOAT RACE

1. A committee should be formed from the group that is interested in the race. The first responsibility of the committee is to select and agree upon the specifications for the boats to be raced. If there are two or more sizes of boats, then specifications for each size or class should be established. Copies of these specifications should be available for each boatbuilder. One of the members of the committee should be given the assignment to duplicate sufficient copies and to distribute them to the adult in charge of each boatbuilding group. The following specifications have been used successfully for a number of years:

SAMPLE SPECIFICATIONS FOR 12-INCH SAILBOAT

HULL

1. The hull must be of wood.
2. The length of the hull from the bow to the transom should be not less than 11½ inches or not more than 12½ inches.
3. The beam, which is the width at the widest point, must not be greater than 5¾ inches.
4. The maximum thickness of the hull at any point must not exceed 2¼ inches or be less than 1⅜ inches.

KEEL

1. The keel must be made of sheet material.
2. The keel may be of any shape but must not project more than 4 inches below the bottom of the hull.

RUDDER

1. The rudder may be of any type.

SAILS

1. The sail area is not limited.
2. The boat may have either a mainsail, or a mainsail and a jib.

IDENTIFICATION NUMBERS

1. Each boat should be marked with a number.
2. When the race is between two or more groups, the boats in each group should be marked with a number and a letter to identify the group.
3. The numbers and letters should appear on the sail near the top of the mast.
4. Duplication of numbers or letters is not permitted.

2. The second responsibility of the committee is to formulate the plans for the race. These arrangements should include the racing program, the scoring plans, and the awarding of the trophy and prizes.

The racing program should specifically state the day, the time of day, and the place where the race is to be held. Provision should be made for an alternate day in case of rain.

Officials needed to conduct the race should be secured in advance by some member of the committee. The duties of the officials should be carefully explained to them before the day of the race. The starter calls the contestants to the starting line. He checks the entries for the race and gives the starting signal. Three judges are recommended for races among 20 or more entries. There should be a judge to determine first place, one to determine second place, and another to determine third place.

If there is a large number of boats, it will be necessary to arrange for elimination races. Each group in the elimination races should be of equal number. If there are several schools racing, each school should be represented by an entry in each elimination race. The winners of the elimination races qualify their entries for the final race.

RACING PROGRAM

The racing program may take any form but should include this essential information:

a. The name of the race.
b. The class or classes of boats to be raced.
c. The place where the race will be held.
d. The date of the race.
e. The starting time of the first elimination race.
f. An alternate day for the race in case of rain.
g. The number of elimination races.
h. The name of the starter.
i. The names of the judges.

ENTRY BLANKS

The use of an entry blank is a convenient method for handling the racing details. One of the committee members should be given the assignment to duplicate a sufficient number of entry blanks and to distribute them to the adults in charge of the boatbuilding groups.

SAMPLE ENTRY BLANK

ANNUAL BOAT RACE

BOY'S NAME____________________

ADDRESS____________________

ELIMINATION RACE NUMBER____________________

ELIMINATION RACE PLACE 1 2 3

FINAL RACE PLACE 1 2 3 4 5

NUMBER OF THE BOAT

An entry blank is issued to each boatbuilder, previous to the race, by the adult in charge who may be the teacher or the club sponsor. The adult in charge will make the elimination race assignments. Each boatbuilder will present his entry blank to the starter when the elimination race, to which he has been assigned, is called. The starter will deliver the entry blanks to one of the judges at the finish line by messenger. The winners of the race should report to the judges for their awards. The judges will indicate on the entry blank the position of the boat at the finish of the race, and return the entry blanks to those who have qualified for the final race. The winners will give their entry blanks to the starter of the final race, and the blanks will be handled in the same way as they were for the elimination race. After the race all the entry blanks are to be retained by the judges to form a record of the race.

SCORING PLAN

This scoring plan has been devised to provide for the recognition of both individual and group winners.

SAMPLE SCORING PLAN

1. Eligibility of boats.

   All boats must conform to the racing class specifications to be eligible for the race.

2. Scoring of points.

Entries.
  Ten points will be scored for each boat entered and sailed.
Elimination races.
  Ribbons will be awarded to the boats finishing first, second, and third.
  All boats placing first or second are qualified to be entered in the final race.
Final race.
  This race is to be run over the same course as the elimination race.
  All boats placing first or second in the elimination races are eligible to enter the final race.
  First place in the final race will score 500 points, second place will score 300 points, third place will score 150 points, fourth place will score 75 points, and fifth place will score 50 points.
  Ribbons will be awarded to the boats finishing first, second, third, fourth, and fifth.
3. Tying contestants.
 Elimination races.
  Duplicate places will be awarded the tying contestants.
 Final race.
  The tying boats are to be raced again.

A copy of the scoring plan, adopted by the committee, should be given to each of the judges. After the final race, the judges will total the points won by each group, and announce the group winner.

PRIZES AND TROPHIES

Recognition of individual winners and of the winning group adds to the success of the race and acts as a stimulation for additional races. Prizes and trophies need not be expensive, because the value of the award lies in its significance and meaning, and not in its monetary value. However, there is some cost, and the race committee will need to plan some method for raising the necessary money. A small entry fee paid by each boy entering a boat is one method that has been successful. The cost of the awards might be divided equally among the schools or groups represented in the race.

Ribbons are relatively inexpensive and a large number of them can be secured for a small sum (Fig. 187). An entry ribbon may be given to each boy who enters a boat in the race. Whether the boy wins a race or not, he has an award that means a great deal to him. The ribbons should be 1½ or 2 inches wide. Different colors may be used for the different awards.

The number of ribbons needed will depend on the number of officials required and the number of races planned. There

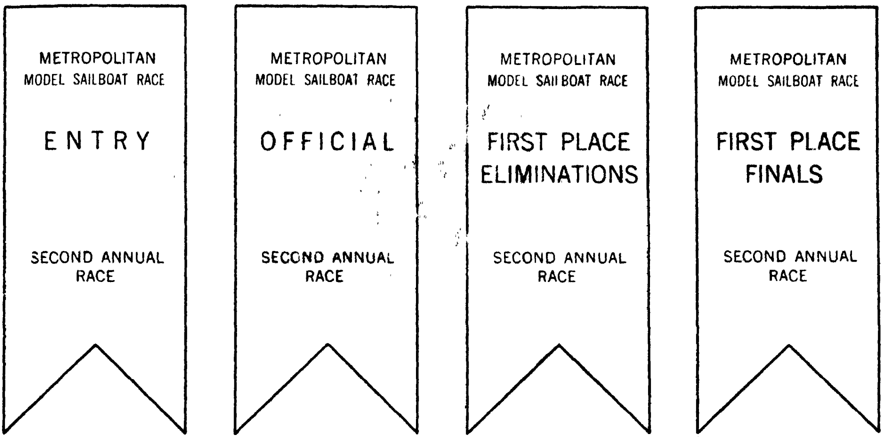
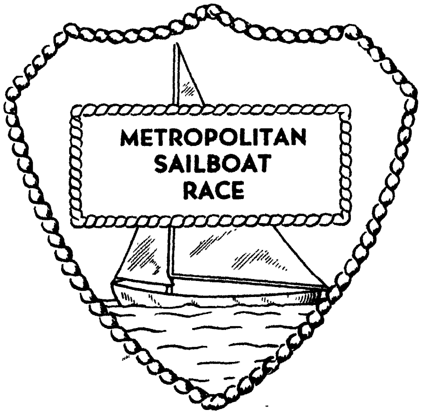


Fig. 187.

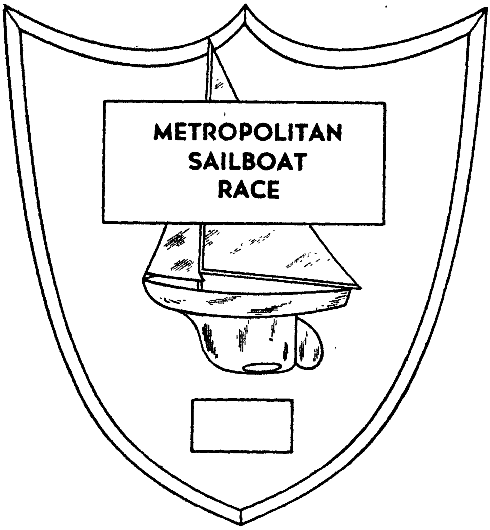


SWEATER EMBLEM

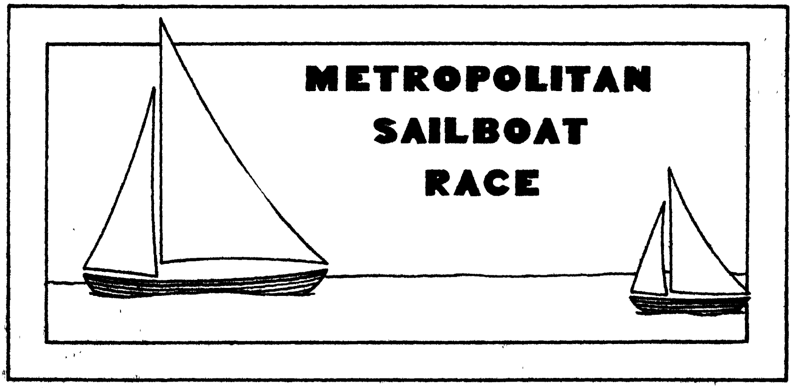
Fig. 188.

hould be a first-, second-, and third-place ribbon for each limination race, and a first-, second-, third-, fourth-, and ifth-place ribbon for the final race. It is desirable to have xtra ribbons in case of a tie.

Sweater emblems (Fig. 188) are popular as awards and also help to advertise the race. The winners of the final race will sew the emblems to their sweaters and find considerable satisfaction in wearing them.

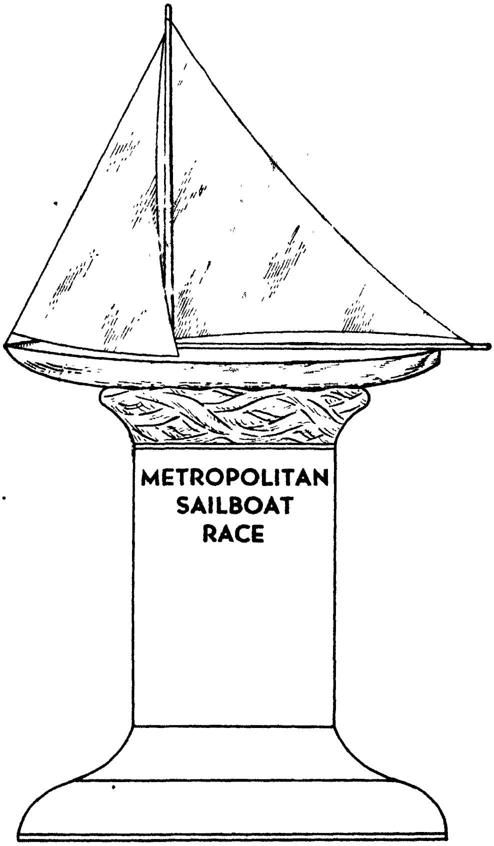


PLACQUE
FIG. 189*A*.



BANNER
FIG. 189*B*.

A trophy should be awarded to the winning school or group. This may be a plaque, trophy, or felt banner (Figs. 189*A*, 189*B*, and 189*C*). If funds are not available, one of the members of the race committee could assume the responsibility of obtaining or making the trophy. Whatever type of trophy is chosen by the race committee, provisions should be made for recording the winner and the date.



TROPHY
FIG. 189*C*.

26. EXPERIMENTAL PROCEDURE FOR IMPROVING THE SAILING QUALITIES OF A MODEL BOAT

The designs of both the 12-inch and 16-inch sailboats were secured after much experimenting. If you wish to change the dimensions of the sails, it will be necessary for you to experiment so that your model will sail well. Experimenting with a boat of your own design is fun. Most boys will not find the experimental procedure too difficult.

CHECK THE BALANCE OF THE SAILS

Before putting the boat in water, tighten the adjusting line so that the pressure of the wind on the sails *will not move* the rudder. Then let out the mainsheet so that the boom will make an angle of about 30 degrees with the center line of the hull (Fig. 190). If the boat has a jib, let out the jib sheet so that the jib sets the same as the mainsail.

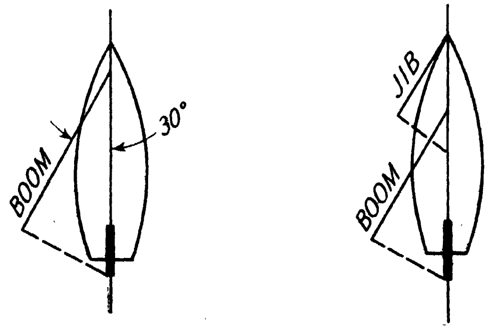
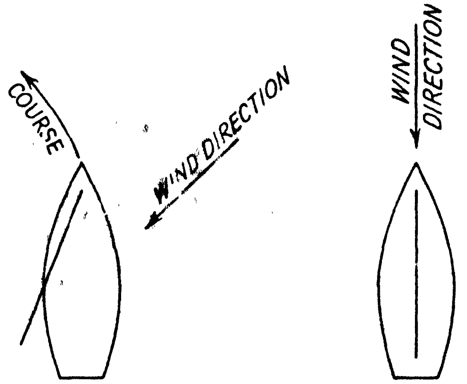


FIG. 190.

When the boat is set in the water, it will sail in a straight course if the sails are properly balanced. Two things may happen if the sails are not balanced: the boat may sail off to the left as in Fig. 191 which is called "falling off the wind," or it may turn around and point into the wind, which is called "heading into the wind."



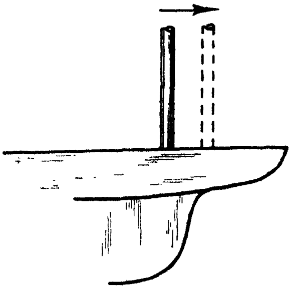
FALLING OFF THE WIND

HEADING INTO THE WIND

FIG. 191.

CORRECTIONS FOR HEADING INTO THE WIND

When the boat heads into the wind, the sails flap from side to side, and the boat will not go forward. Adjustments on the rudder, boom, or jib will have no effect on the sailing of the boat. Any one of several alterations should remedy this condition. The first thing to try is to change the location of the mast by moving it forward of its present position. Experimenting

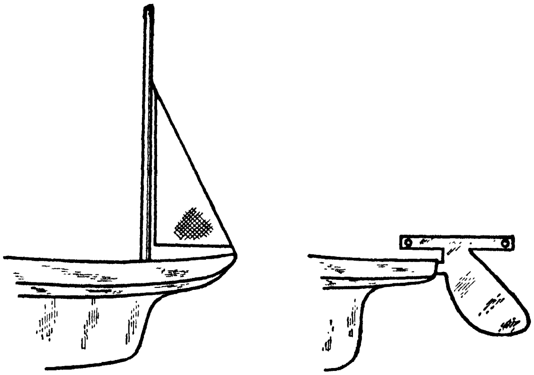


MOVING THE MAST FORWARD

FIG. 192.

with the mast in several locations will help you to determine the position where the boat will respond best to the pressure of the wind on the sails.

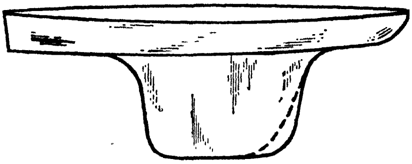
If the mast is moved forward as far as possible (Fig. 192) and the boat still heads into the wind, a larger jib should be installed. If this alteration does not correct the tendency of the boat to head into the wind, then make and install a larger rudder.



INSTALL A LARGER JIB

MAKE A LARGER RUDDER

FIG. 193.



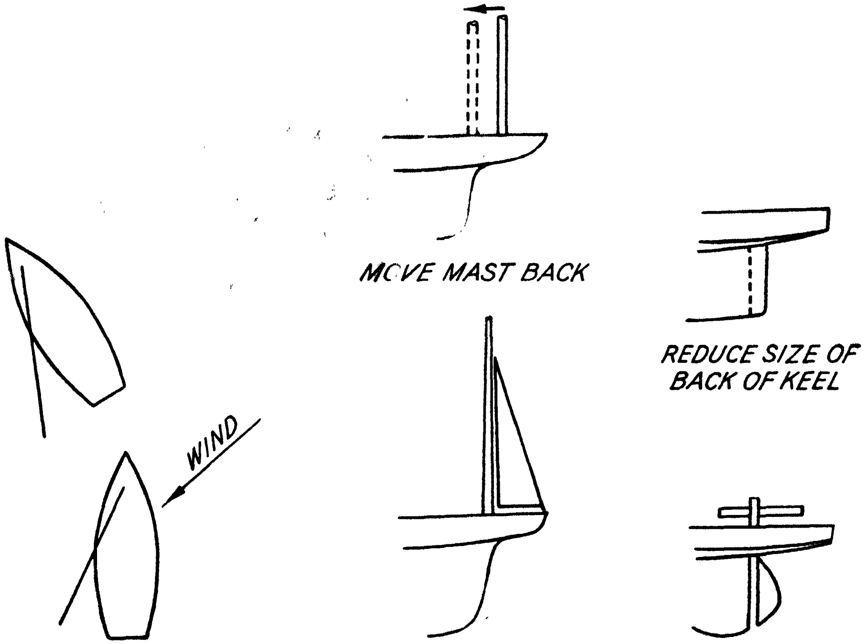
REDUCE THE SIZE OF THE KEEL

FIG. 194.

Experimenting with larger jibs, larger rudders, and mast positions should enable you to correct any tendency of the boat to head into the wind (Fig. 193). There is a possibility that in spite of alteration of all three of these, the boat will still refuse to sail. As a last resort, cut down the front curve of the keel (Fig. 194).

CORRECTIONS FOR FALLING OFF THE WIND

When the boat falls off the wind, even though the boom is hauled in as close as possible, its speed is slow and it looks as though it would tip over with each gust of wind. Any of these alterations (Fig. 195) will remedy this condition:



MOVE MAST BACK

REDUCE SIZE OF BACK OF KEEL

CORRECTIONS FOR FALLING OFF WIND

MAKE SMALLER JIB SAIL

REDUCE SIZE OF RUDDER

Fig. 195.

1. Move the mast back.
2. Make the jib smaller.
3. Reduce the size of the rudder.
4. Cut down the back of the keel.

ADJUST THE TENSION ON THE RUDDER

The tiller is constructed so that the mainsheet may be attached to either end (Fig. 196).

If, after balancing the sails as closely as possible, the boat has a slight tendency to head into the wind, fasten the mainsheet at the back of the tiller (Fig. 197). The pressure of the wind on the sail will turn the rudder. The less tension on the rudder, the easier the rudder will turn, and the less the boat will sail into the wind. By varying the tension on the rudder (Fig. 198), the boat can be caused to sail the course desired.

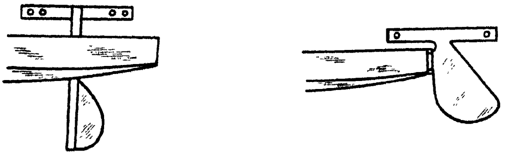


Fig. 196.

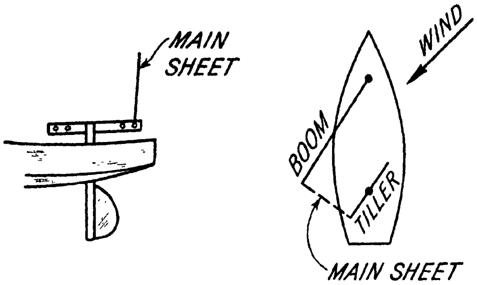
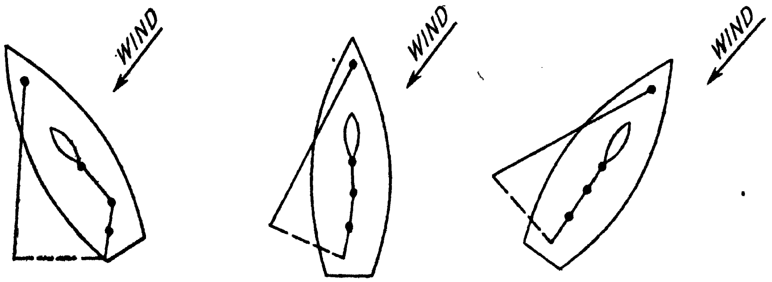


Fig. 197.



LOOSE RUDDER

MEDIUM RUDDER

TIGHT RUDDER

Fig. 198.

If the boat has a slight tendency to fall off the wind, the mainsheet may be attached to the front of the tiller (Fig. 199). The wind pressure on the sail turns the boat to correct for the tendency to fall off the wind. By varying the tension on the rudder (Fig. 200), the boat can be caused to sail the desired course.

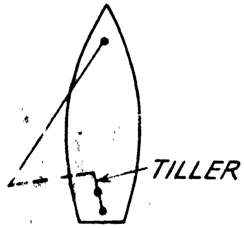


FIG. 199.

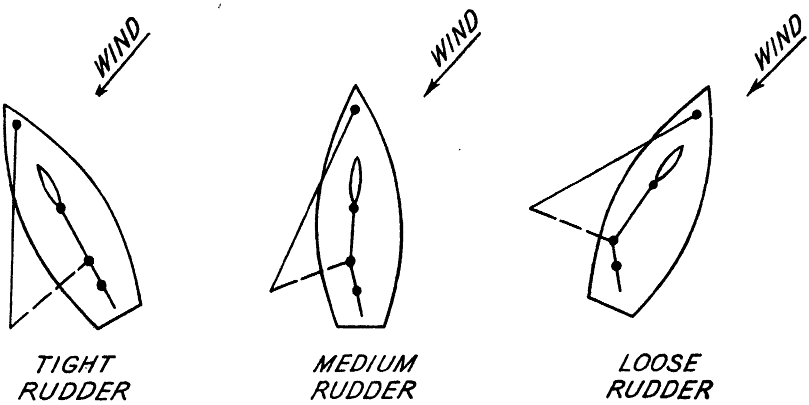


FIG. 200.

In adjusting the rudder keep in mind that the sail should be balanced so that the boat has a slight tendency to sail either into the wind or to fall off the wind. The rudder should have the right amount of tension.

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